Gas Journal

APRIL 15, 1936

Vol. 214 88th Year No. 3804

Editorial Notes

Dealer Co-operation

THE Southport Chamber of Trade has had under discussion the question of municipal trading—the sale of gas and other appliances at the showrooms of the Corporation. The point made was that municipal services should not include trading activities of buying and selling in competition with " ordinary traders;" and a resolution was carried to the effect that the Chamber views municipal trading with grave concern, and hopes that no extension will take place in the future. A Mr. Gorse, of the Ironmongers' Association, regards with chagrin the sale of gas fires, cookers, and so on, at the " big gas showroom," and with still greater chagrin the sale of gas refrigerators. He said he did not know when refrigerators became gas appliances; this lack of knowledge may go far to explain his attitude.

To our mind, this attitude is definitely opposed to the interests of the small private trader. We hope and believe that our Industry is out to foster co-operation with what has come to be known as the " dealer;" and we expressed the opinion in these columns some time ago that if dealer co-operation is to be pursued effectively throughout Great Britain some agreement will have to be arrived at as to the margin of profit on the sale or hire purchase of apparatus. In no circumstances can any such scheme achieve success unless the dealer is able to fix his prices in accord with those offered by the gas undertaking, and at the same time be assured of a monetary gain which will provide him with ample incentive to push the sales of gas appliances. As things stand at present, there is too great a degree of diversity in the sales methods adopted by different undertakings; the prices at which appliances are retailed vary widely from area to area and even in adjacent districts.

We suggest to the Southport Chamber of Trade that co-operative trading with gas undertakings offers great possibilities and that there is no sound reason for the declared antagonism of the private dealer. We suggest, too, that the dealer has himself to blame for the position at which he grumbles. Prior to, and after, the War it was imperative, as we have emphasized before, that the Gas Industry should take into its own hands the installation of gas appliances. Installation work was being undertaken by plumbers and builders who knew next to nothing about gas fitting in relation to gas service. Premises by the thousand were carcassed with pipes totally inadequate to cope with the demands of the consumers. Complaints of " bad gas " inevitably followed. On majority, the Southport Chamber of Trade maintains that the sole function of the Gas Department is to make gas, and virtually to let others sell it. The aim of the Southport Gas Department—as, indeed, it is of the Industry in general—is to provide its consumers with gas service. It is of no avail to manufacture gas unless it is sold effectively as a service. The Gas Industry had, in fact, no alternative but to educate the public as to what gas service really means. Showrooms were erected appropriate to the business in hand, and individual undertakings saw to it that the fitting work and servicing was up to specification. The outcome of this work was a raising of the standard; and it is a fact to be deplored that this desirable result should have been the cause of antagonizing the small dealer.

All Round Benefit

THERE is, we repeat, no need for this antagonism. Gas undertakings are—or should be—desirous of enlisting the support of the dealer—plumbers, builders, decorators, ironmongers, general stores, furnishing houses—and the dealer should be made to appreciate that his support means his benefit. There would be then less of the childish sort of debate indulged in by the Southport Chamber of Trade. At the same time, we would emphasize that any dealer co-operative plan should have as a *sine qua non* strict supervision of installation work, and that dealers should display and sell only appliances approved by the gas undertakings.

We are reminded of the co-operative scheme which is being operated with such admirable results to all concerned by the Gas Light and Coke Company. The main points of this scheme—it is by no means the first to be put into operation, but in view of the Company's extensive area it is a very important one—are that the dealer is asked to provide space for the display of appliances and to take a keen interest in the work. He is asked for no capital, for the stock is supplied by the Company, who also loan the necessary material for displays and demonstrations. The idea is that authorized shops shall in part be gas showrooms. No restriction is made as to the type of appliance sold except that it must be approved by the Company. The trader receives a commission on sales and on any business he may introduce, and if he prefers he can take his customers to the nearest showrooms of the Company. All the necessary contract forms for hire and

hire-purchase business are supplied, and on these terms the customer pays direct to the Company, so that the dealer is spared the duty of collecting money. The scheme has resulted in a large increase in direct contacts with the ordinary householder and property owner, which are so important for increasing the sales of gas equipment, and it has proved highly popular with the dealers. We do not say on the same lines, but it is on lines such as these that the Southport Chamber of Trade and the local Gas Department might well get together. It would, we think, obviate the Chamber's desire to pass what are, after all, purely obstructive resolutions. Both the Gas Department and the traders would benefit by such reasonable co-operation, as, incidentally, would the consumers of gas in the Southport district.

District Co-Operation

We are very glad that the policy of sales co-operation in districts, which we have for long advocated, is meeting with consideration and in many directions with acceptance. We have no doubt that this system of co-operative district effort is essential if full value for money is to be gained, and that upon it much of the future progress of our Industry will depend. In the foregoing, discussing dealer co-operation, we have suggested the desirability of undertakings adopting an agreed policy. Working to a common policy is necessary in many other activities. A fortnight ago in these columns we emphasized once again that many competition difficulties in selling coke can be solved by the formation of district coke associations, co-ordinated through one centre. The London and Counties Coke Association has amply demonstrated the success of operating on a plan of co-ordination. It has evolved a system of price regulation which works smoothly, and its technical resources are great. Its activities have without question greatly enhanced the reputation of coke as a fuel, and the Association has given full assurance that all help possible will be given to other areas which may be aiming at the establishment of district associations. Among the latest activities of the Association has been the launching of a display scheme. Particulars of this move were given in the "JOURNAL" for April 1. After consultation with the B.C.G.A. studios, the Association has made available to members a series of displays, posters, and showcards suitable for showroom and window exhibition. Use of this service by the undertakings throughout the area will ensure a sales appeal far more powerful than disjointed isolated efforts, and at comparatively little cost.

One has only to think for a moment of what benefits have resulted from the district co-operation and central co-ordination of the Industrial Gas Development Centres to gain a picture of the enormous potentialities of co-operation. These Centres have brought about a new understanding between gas undertakings and makers of appliances and between both and the industrialists who install the equipment. Their activities have resulted in a vast improvement in the thermal efficiency and appearance of gas furnaces, in the development of automatic control, and in widening the scope of gas usage. In connection with "scope" we may mention the successful research on furnace atmospheres. The value of these Centres has been amply demonstrated, and it points to the fact that the next move must be to develop the domestic load on similar lines, working, as we have said, to an agreed policy.

We have already noted with satisfaction in the "JOURNAL" the combined effort to push the sale of gas for refrigeration, and that, to meet the enormous demand confidently anticipated, Electrolux, Ltd., the makers of gas refrigerators, decided to cease manufacture of electric models, greatly to extend their factories, and concentrate solely on those run by gas. We learn that already 360 gas undertakings have agreed to combine for the refrigeration "drive." Forty-one of them, in and around London, are known as the "London Group," and we have mentioned the advertisements, issued jointly by the undertakings comprising this Group, which are appearing in the National Press.

A Move to be Welcomed

We hope that this scheme may be the forerunner of many other co-ordinated district sales campaigns backed by similar grouping and powerful joint propaganda, and covering in turn many of the other uses of gas in the domestic field. There is no doubt, for example, that more and more efforts are desirable to extend the water heating load, and we should like to see co-operative drives in this direction. It may be that national sales policy, which at the moment is quite frankly nebulous, may eventually find the best outlet for its activities in the shaping and co-ordinating of district sales policies and campaigns—a move which would be welcomed in many quarters with unprecedented enthusiasm. In the meantime, a lead is required in each district from one prominent undertaking which is sufficiently far sighted to realize that it will be helping itself just as much as its neighbours by inspiring them with a joint battle cry, and with the fighting spirit for a series of joint campaigns. The finding of such leaders should not present much difficulty. In fact, it would not take anybody much thinking to name them off-hand.

Co-operation in advertising and display means that the force of the publicity is enormously increased at the least expenditure of money. People travelling about the districts are continually being brought face to face with the gas story. The more district advertising "catches on," the better. It is bound to make for brighter and more effective propaganda, and it will cater for the fact that conditions in different areas of supply vary. The outlook of people in the South Wales coalfields, for instance, is by no means that of people either in the heart or the outskirts of London; uniformly planned local publicity is not to be recommended. The aim should be national propaganda backed up by specially planned publicity suited to each district; and in this district planning the British Commercial Gas Association can be of great help. For example, considerable attention has of late been paid by the Association to schemes for the interchange by gas undertakings of showroom displays, posters, and so on: and a scheme has been evolved whereby, for a nominal yearly fee, gas undertakings can enjoy the advantages of a continuous and ever-changing series of display units in their windows and showrooms. If, as a further step, undertakings in a district got together, decided what type of display was best suited to their needs, and invoked the aid of the B.C.G.A., the strength of the propaganda appeal would be far greater—and there is no reason why this course should not be taken. Frequent change of display is desirable, and it is also desirable that the displays themselves should be of a high standard. The motor 'bus services bring all in easy reach of shopping centres where goods are attractively displayed, and even dwellers in villages expect attractive showroom windows. Groups of undertakings should decide to get the best value for expenditure by interchange. The standard of showroom window display varies greatly throughout the country; and those undertakings which are behind the times in this respect harm not only their own business but that of their more progressive neighbours.

Benzole Treatment

On later pages to-day we conclude publication of a communication by Messrs. Hoffert, Claxton, and Hancock, of the National Benzole Company, on the restricted treatment of benzoles with sulphuric acid, before stabilization with gum-inhibitors. They have tackled the problem with characteristic thoroughness and with a large amount of experience to guide them. The work they describe was undertaken to discover the best method of using sulphuric acid to bring about a selective removal of the objectionable constituents of crude benzoles, such as pyridine and sulphur compounds, with at the same time the minimum destruction of the unsaturated hydrocarbons, which, if necessary, can be stabilized by the use of inhibitors. We think it will serve a useful purpose if we refer here to the main findings of the investigation.

A refined benzole should be gum-stable, free from colour on storage, and contain not more than a specified quantity of sulphur, and in the refining process these objects should be achieved with the minimum loss of saleable products. The use of inhibitors enables gum stability to be obtained with practically no loss. Sulphur present as carbon disulphide can be removed with only small losses either by chemical means or by the use of special fractionating columns; but, state the authors, from the point of view of yield it is more advantageous to remove carbon disulphide by chemical means than by fractionation. In this connection we are reminded of the Paper on benzole recovery and refining which Messrs. Wikner and Richardson presented to The Institution of Gas Engineers in June of 1934, in which, referring to the methanol-soda process for the removal of carbon disulphide which they operated at Newcastle, they observed that, interesting as it is in the chemistry involved, it is not a pleasant process to work.

In regard to the removal of thiophen sulphur, Mr. Hoffert and his collaborators conclude that sulphuric acid remains the simplest and cheapest reagent for the purpose. As a result of the investigation which they detail, it is also concluded that for any particular benzole the yield obtainable bears a definite relation to the quantity of thiophen removed and is independent of the amount and strength of acid necessary to cause this removal; also, that variation in temperature and the addition of catalysts to the acid do not appear to affect this relationship. Hence for any benzole it is possible by treatment with acid to establish a fundamental sulphur-yield curve which affords a basis for comparing other processes with sulphuric acid treatment; and so far the authors have found no refining treatment which shows any advantage over sulphuric acid in this respect. Colour and pyridine bases are removed by sulphuric acid simultaneously with the thiophen, and with normal benzoles acid of 70 to 80% strength is sufficient to remove the colour. The use of small amounts of concentrated acid is not recommended for removing pyridine bases.

The main conclusion which the authors draw from their work is that there is still much to recommend the use of sulphuric acid as a preliminary refining agent on account of its simplicity and general effectiveness. The acid treatment given, they observe, can be reduced to the minimum necessary to remove excessive amounts of thiophen sulphur. Little or no regard need be paid to stability, since this can be obtained by the use of inhibitors. The choice of the exact strength and amount of sulphuric acid required is governed to a large extent by factors such as the ease with which the acid can be contacted with the benzole, its subsequent separation, the liability towards sulphur dioxide formation, &c.; but for many benzoles of moderate sulphur content, acid of 80 to 85% strength is most suitable. From the point of view of the strength and amount of acid required to cause a certain sulphur reduction in a benzole low in unsaturateds but of high thiophen content, the advantages of blending this benzole with one of high unsaturated content should be borne in mind.

Electrical Competition

In these columns last week we referred generally to the Report of the Central Electricity Board covering the year ended Dec. 31, 1935; and we mentioned that during the year the amount of electricity generated in Great Britain was 17,565 million units, which represents an increase of 1,900 million units over the 1934 figures. It is interesting to look more closely into these figures and to find out what they signify to our Industry. Percentage figures are, of course, in themselves of little value. An increase of 2 units sold is 100% increase if previous sales amounted to 2 units; but a newspaper headline of "A hundred per cent. increase" looks pretty good, and naturally a young industry like electricity has not been slow in making capital of "percentage increases." Our own Industry, quite rightly, has interpreted these percentage increases into volume of business done, and on a heat energy basis this volume is small in comparison with that done by gas. In some quarters in the Gas Industry this method of analysis has given rise to not a few "pooh-poohs" and an air of benevolent complacency.

We say right away, however, that there is little room for complacency when we analyze the figures of the Central Electricity Board for 1935. The increase of 1,900 million units is equivalent to an increase of 12% over 1934. On a heat energy basis, seeing that a therm is the equivalent of 29·3 units of electricity, the 12% increase represents 64 million therms. These therms, translated into gas of a calorific value of 500 B.Th.U. per cu.ft., mean 12,800 million cu.ft. The total sales of the Birmingham Gas Department are round about 14,500 million cu.ft.; and as their declared calorific value is 475 B.Th.U. per cu.ft., it can be seen that the increase in electrical units in 1935 is, on a thermal basis, not far short of the heat energy sold as gas by the Birmingham Gas Department. There are few grounds for complacency about this.

Let us make another comparison. The latest Board of Trade Return relating to authorized gas undertakings in Great Britain covers the year 1934. It records an increase of 1·6% in the gas sold compared with the preceding year—a matter of 4,520 million cu.ft. This is far short (again on a heat energy basis) of the gain electricity shows for 1935. And if any reader cares to work it out, he will find that our Industry should have recorded an increase of 4½% in 1934 to draw level, on a heat energy basis, with the electrical gain. Moreover, to draw a true picture, it is necessary to go a step further. We have been at pains to emphasize the "heat energy basis." This is useful as a guide, but must never be regarded by our Industry as giving an absolute comparison between gas and electricity. While a therm is equivalent to the heat energy of 29·3 units of electricity, efficiencies of utilization of gas and electricity have to be taken into account. Allowance must be made for the higher thermal efficiency in use of electricity; and when this allowance is made it is clear that our Industry cannot regard an annual increase of 5% in gas sales with equanimity. Before we can chortle we need more than a 5% annual increase.

We have in the foregoing endeavoured to give a clear interpretation of the increase in the amount of electric current recorded by the C.E.B. in its relation to the Gas Industry. We have done so in no panicky spirit, for we

firmly believe that the Gas Industry has the means in its power to increase its sales vastly. But it must exercise its means—and this can only be done by cohesion throughout and enterprise. The C.E.B. Report for 1935 calls for determination on the part of every gas undertaking; it is not a scrap of use wasting breath and time trying to belittle the progress of electricity.

We have not discussed the financial aspect of the Grid, to which we may return on another occasion. But, having perhaps made the flesh of our own Industry creep by pointing out the positive achievements of electricity, we would make it perfectly clear that there are no signs of the slaughter of gas of which our competitors openly speak, or of its early demise which is still regarded as inevitable by so large a proportion of the public who are sated with electrical propaganda. The year 1934 was not a favourable one for gas, and yet the Industry showed no decline in output. On the contrary, as we have already stated, it showed an *increase* of 4,520 million cu.ft. It is quite safe to say, from figures already to hand, that the 1935 increase will have been a deal greater than this.

News in Brief

Tenders Are To Be Obtained by the Darlington Town Council for the installation of a water gas plant at the gas-works.

An Increase in the Price of Gas has been decided upon by the Warrington Town Council. This involves an extra 2d. per 1,000 cu.ft. to meet the increased cost of coal.

A Double Deck Omnibus has been placed at the disposal of the Wallasey Gas Department by the Corporation for the purpose of fitting the necessary equipment for experimental purposes in connection with the use of compressed coal gas as a fuel.

The Electricity Supply in the western part of Crieff failed on the evening of April 4 for 30 minutes. Occurring at 7.30, the busiest time of the evening, shopkeepers were much inconvenienced. The breakdown was due to a fault in one of the transmission cables.

The Price of Gas at Bo'ness has been increased by 2½d. to 4s. 2d. per 1,000 cu.ft. for ordinary meters and to 4s. 8d. for slot meters. This advance has been rendered necessary by the rise in the price of coal for the benefit of the miners, and the new rates come into operation after the present survey of the meters has been completed.

Applications are Invited for the appointment of Gas Engineer and Manager to the Skipton Urban District Council. The commencing salary will be £300 per annum, rising on approved service by yearly increments of £20 to a maximum of £400, *plus* house, rates, fuel, and light. Further particulars of this appointment will be found on our advertisement pages.

The 12th International Congress of Acetylene, Oxy-Acetylene Welding, and Allied Industries will be held from July 8 to 13 in London. Members representing firms from all over the world have arranged to attend, and it is hoped that British industrial undertakings will also be fully represented. This Congress will have the unique distinction of being honoured by Royal Patronage, and celebrates two significant anniversaries in the history of oxy-acetylene welding.

The Renaissance of the Gas Industry through the adoption of modern publicity methods was referred to by Mr. G. J. Freshwater, the well-known publicity and sales promotion manager, in an address which he gave at Manchester. As the result of a great deal of spadework, he said, brought about by the challenge of the electricity industry, the gas interests participated in a co-ordinated effort and had succeeded in bringing about a colossal increase in the consumption of gas. The Industry had forged ahead in a most surprising manner by showing the public what gas could and would do.

More Than Usual Interest in modern methods of gas cooking was manifested at the well-attended sessions of Practical Cookery Demonstrations at Oddfellows Hall, Whitehaven, where successful lectures were given by Miss E. Eccles, C.D.S., of Cannon Iron Foundries, Ltd., Research Kitchen. Arrangements were made enabling the attendance of schoolgirls in the afternoons, and great keenness was shown in the Juvenile Cake Baking Competition. Numerous entries in a similar competition for adults was gratifying testimony to the ability of modern housewives, and to the high standard attained in gas cooking. Under the supervision of Mr. J. Denham (Engineer and Manager of the Whitehaven United Gas Company) an exhibition of gas appliances was well arranged.

An Interim Dividend at the rate of 3½%, free of income-tax, is to be paid by the Directors of the Oriental Gas Company on May 30 on account of the year ending June 30 next.

Considerable Interest was shown in the cake-baking competition held in conjunction with the gas cookery demonstrations at the Central Office of the Cheltenham and District Gas Company towards the end of March. Some difficulty was experienced by Miss Joyce Williams, the Radiation expert, in selecting the winning cakes. The Accountant and Commercial Manager (Mr. A. L. Morris) informed the crowded audience of the Company's pleasure at the enthusiasm shown in the competition and congratulated the successful entrants. The prizes were handed to the winners by Mrs. A. L. Morris.

Personal

Mr. N. B. THOMPSON, Engineer and Manager of the Skipton Urban District Council Gas Department, has been appointed to a similar position with the Ormskirk and District Gas Company, taking up duty in May. Mr. Thompson is a son of the late Mr. J. W. Thompson, Engineer and Manager at Barnoldswick. He went to Skipton as Assistant Manager in 1923 and took over chief control on the death of Mr. J. Woodward in 1928.

* * *

Mr. S. NEAL, Chief Clerk of the Bury Gas Department, who is to retire on April 30, has been in the service of the Corporation for a period of 50 years.

* * *

The Corporation of Glasgow have ratified the appointment of Mr. EDWARD J. STEWART as Inspector of Lighting in succession to Mr. S. B. Langlands, and of Mr. JAMES M. WARD to succeed Mr. Stewart as Assistant Inspector of Lighting, as from July 26 next.

Obituary

Mr. Harold Shewring.

His many friends in the Gas Industry will have been profoundly shocked at the death in such tragic circumstances on Tuesday of Mr. Harold Shewring, Engineer and Manager of the Cambridge University and Town Gas Light Company.

He was sailing with a friend in the latter's 10-ton yacht from Weymouth to Cowes, when, at a point near Lulworth Cove, the main boom swung across the boat, knocking Mr. Shewring overboard. The owner threw a rope to him, but in some way it became entangled in his own legs, dragging him also into the water. The other occupants of the yacht were the two men's sons, who were powerless to assist their fathers, both of whom were drowned.

Mr. Shewring only took up his appointment with the Cambridge Company a little over a year ago, having previously occupied a similar position with the Rochdale Gas Department. He was about 47 years of age and leaves a widow, two sons, and a daughter, to whom we feel sure the whole Industry will join us in extending the deepest sympathy in their sudden and tragic bereavement.

A Paper by Dr. J. G. King on "The Technique of Hydrogenation of Coal and its Products" is to be presented at a meeting of the Institute of Fuel to be held at Burlington House, Piccadilly, W. 1, on April 23. After the meeting an informal dinner will be held at the Café Royal, Regent Street.

There was an Increased Gas Consumption at Lincoln last year of no less than 63 million cu.ft. This was over 10% more than in the previous year, and was by far the largest increase in the history of the undertaking. Both gas and electricity supply services at Lincoln are municipally owned.

Applications will be Received by the Department of Coal, Gas, and Fuel Industries of Leeds University up to Thursday, May 14, for an Open Fellowship of £200 per annum, established by The Institution of Gas Engineers for the prosecution of post-graduate Research in Gas Chemistry. Further particulars may be obtained from the Clerk to the Senate, The University, Leeds.

In Competition with Electricity, the Wellington (Salop) Gas Company have secured a five years' contract with the Oakengates Urban District Council for public lighting, comprising some 300 lamps. The Company's scheme for a modern installation of high-powered lighting for the shopping area has also been accepted, the entire cost of the installation being borne by the gas undertaking.

The Entire Cooking and Catering Equipment at the reconstructed King's Arms Hotel, Morecambe—a rebuilding which has occupied about a year—is by gas. The hotel, as reconstituted and re-furnished, was officially opened last week by the Rt. Hon. Lord Brocket. The kitchen equipment, intended for catering on a large scale, includes cooking ranges, fish fryers, steamers, soup boilers, water boilers, hotclosets, and heated carving table.

New Showrooms have been opened by the Blyth Gas Company at Bedlington. The opening ceremony was performed by Mrs. C. S. Kidd, wife of the Chairman of the local Council. Mr. R. G. Dobson (Chairman of the Blyth Gas Company) said that the new building was being opened for the benefit of several thousands of consumers in the Bedlington area. Among representatives of the Gas Company present at the ceremony were Mr. C. Rutherford (Deputy-Chairman); Messrs. A. J. Turnbull, A. Thompson, and J. G. Robertson (Directors); Mr. J. R. Gledson (Secretary); and Mr. J. Eadington (Manager).

A Case of Interest to the Gas Industry arose at a sitting of the Glasgow Burgh Valuation Appeal Court on March 30 when the question of whether gas cookers installed in service flats became heritable or movable property. A lessee of service flats at 3, Sydenham Road appealed against the City Assessor's valuation of £55 on the Supplementary Valuation Roll. For the appellant it was argued that gas cookers could not be regarded as part of the heritage. The City Assessor claimed that it became heritable by being attached to a heritable subject. The Court dismissed the appeal, and the appellant asked for a stated case.

A Preference for Gas on the part of council house tenants was recently discussed at a meeting of Tranent Town Council, when a letter was read from the Tranent Gas Company, stating, in reply to the allegation made that certain tenants in the Council's housing scheme were using gas for lighting where electricity was installed, that the Company had never fitted any lighting brackets but had sold a number of table lamps to people who had complained of the cost of electricity. The Town Clerk said that they could not possibly refuse tenants permission to install gas, while Bailie Lindores maintained that the Gas Company had only been allowed to install gas for cooking. Ultimately the Council decided to make further enquiries.

A Model Gas-Works loaned by the Birmingham Gas Department and worked by one of the pupils was a great attraction at an exhibition recently organized by the Worcester Royal Grammar School Science Society. The various departments were scheduled in catalogue form, including architecture, aviation, civil engineering, resin products, lighting, fuels, scientific instruments, &c. The Worcester New Gas Light Company had a display in the fuels section, including the model gas-works, "Electrolux" refrigerator with diagram showing the heat interchange cycle, sectioned "Regulo," diagram of same and latest model coloured "Regulo" cooker, glass-cased slot meter, catalytic lighting, switch and "daylight" gas mantle with coloured wools and matching cabinet, also a "Calor" gas outfit. Considerable publicity was given in the local Press and the Company are well satisfied with the results of their co-operation.

Gas Progress at Warrington

Increasing Industrial Load

Warrington Corporation has decided to install a new 2,500,000 cu.ft. gasholder at a cost of £27,000, to replace one which has been in use at Longford for 41 years. The Gas Undertaking is hoping next year to produce 4 million cu.ft. of gas per day.

At the last Town Council meeting, the Mayor, referring to the increased demand for gas for industrial purposes, gave figures of a local firm which in 1931 took 6,750,000 cu.ft. of gas; this year they took 97 million cu.ft. It had been decided to increase the price of gas by 2d. per 1,000 cu.ft., bringing the price to 3s. 2d.

The profit on the gas undertaking last year was £10,807, when gas was sold at 3s. per 1,000 cu.ft. If they continued to sell at that price, they would have a balance on the wrong side at the end of the year. The gas undertaking was worth £500,000, and the Gas Committee felt that they could not afford to deplete their reserve fund, as they had many improvements to make in the future which were absolutely necessary if they were to provide an adequate gas service.

Forthcoming Engagements

April.

16.—S.B.G.I.—Council Meeting at 2.30 p.m.
18.—YORKSHIRE JUNIOR ASSOCIATION.—Meeting.
18.—WESTERN JUNIOR ASSOCIATION.—Meeting at Plymouth. Presidential Address of Mr. J. H. Dyde.
18.—WALES AND MONMOUTHSHIRE JUNIOR ASSOCIATION.—Annual General Meeting at Caldicot.
21.—I.G.E.—Gas Education Executive Committee, 11 a.m.; Gas Education Committee, 2.30 p.m.
23.—I.G.E.—Joint Lighting Committee, 2.30 p.m.
24.—N.G.C.—Annual Meeting of Members in Scotland at Central Station Hotel, Glasgow, at 2.30 p.m.

May.

1.—I.G.E.—Liquor Effluents and Ammonia Committee, 11.15 a.m.; Joint Research Committee, 2.30 p.m.
1.—LONDON AND SOUTHERN JUNIOR ASSOCIATION.—Annual Business Meeting.
5.—I.G.E.—Research Executive Committee, 2.30 p.m.
6-7.—EASTERN COUNTIES GAS MANAGERS' ASSOCIATION.—Spring Meeting at Lincoln.
7.—MIDLAND ASSOCIATION OF GAS ENGINEERS AND MANAGERS.—Spring Meeting at Northampton.
7.—MIDLAND JUNIOR ASSOCIATION.—Annual General Meeting. Address by Mr. E. W. Smith.
8.—NORTH OF ENGLAND G.M.A.—Annual Meeting at Newcastle and Lecture by Prof. J. W. Cobb, C.B.E.
9.—SCOTTISH EASTERN JUNIOR ASSOCIATION.—Annual General Meeting.
13.—S.B.G.I.—Annual Meeting and Dinner.
13.—YORKSHIRE JUNIOR ASSOCIATION.—Meeting at Leeds with Salesmen's Circle.
19.—I.G.E.—Gas Education Executive Committee, 2.30 p.m.
21.—WALES AND MONMOUTHSHIRE ASSOCIATION OF GAS ENGINEERS AND MANAGERS.—General Meeting at Monmouth.
26-29.—I.G.E.—Annual General Meeting.

June.

8.—I.G.E.—Finance Committee, 1.45 p.m.; Membership Committee, 2.15 p.m.; General Purposes Committee, 3 p.m.
9.—I.G.E.—Council Meeting, 10 a.m.
16.—I.G.E.—Gas Education Executive Committee, 2.30 p.m.
18.—I.G.E.—Refractory Materials Joint Committee (Stoke-on-Trent), 2.30 p.m.
23.—I.G.E.—Gas Education Consultative Committee, 2.30 p.m.
24.—I.G.E.—Board of Examiners (Oral Examinations), 9.30 a.m.
30.—SOUTHERN ASSOCIATION.—Annual Summer Meeting.

July.

3.—MANCHESTER DISTRICT ASSOCIATION.—Manchester Meeting.

Women's Gas Council

Summer School for Demonstrators, Cardiff, Sept. 11-15, 1936

The Women's Gas Council is arranging a week-end Refresher Course for Demonstrators to be held at the Domestic Science College (University of South Wales and Monmouthshire), Cardiff, from Friday evening, Sept. 11, to Tuesday, Sept. 15 next.

The fee for the week-end (including board) will be £2 2s., and it is suggested that the Course shall include the following:

Scientific cooking by a member of the staff of King's College of Household and Social Science.
Dietetics by Miss Davies, of Cardiff Domestic Science College.
Refrigeration by an expert provided by the manufacturers.
Fruit and Vegetable Preservation by Miss Ferguson, of the Research Station, Department of Agriculture and Horticulture, Bristol University.
Modern usage of canned goods by a Demonstrator from the Usk Agricultural Institute, Monmouthshire.
Lecture demonstrations by well known Chefs provided by the Universal Cookery and Food Association, with particular reference to possible new dishes for inclusion in Gas Cookery Demonstrations.
One session to be devoted to Committee procedure, duties of a Chairman, Secretary, taking of minutes, &c.

and, if it is thought necessary, talks on the following may also be included:

What is expected of a Demonstrator.
How to plan the daily work of a Demonstrator.
Home Service in relation to Gas Sales.
Gas Appliances.

As numbers are limited, the Organizing Secretary, Miss K. M. Halpin, will be most grateful if intending participators will let her know *as soon as possible* if they wish a place reserved. This need only be a provisional reservation but will enable her to know those who are interested and to whom further information may be sent.

A Hundred Years of Gas Service at Horsham

New Showrooms to Celebrate the Occasion

One hundred years of progress are being celebrated by Horsham Gas Company, and to mark the centenary they officially opened their spacious new showrooms and offices at 19, London Road, Horsham, on March 30.

About 50 people attended a luncheon and the opening ceremony was performed by Mr. J. C. Padwick, Chairman of Horsham Urban Council.

In addition to members of the local Council, those present included: Mr. W. H. Bennett (Chairman of Directors), who presided, Mr. F. S. Rowland, Mr. W. Lees Stenning, and Mr. J. Urquhart (Directors), Mr. J. W. Halstead (Engineer and Managing Director), Mr. J. I. Eager and Mr. W. Hammond (former Directors), and Mr. H. Rowland (Secretary of Horsham Gas Company), Mr. A. E. Whitcher and Mr. J. H. Donaldson (Directors), and Mr. D. K. Bourne (Secretary of Associated Gas and Water Undertakings, Ltd.), Mr. B. Long (General Manager and Secretary of the Horley Gas Company), and Mr. A. Tennant (Sales Manager of the East Surrey Gas Company).

Before the luncheon, Mr. Bennett, addressing the gathering, said that last summer the Horsham Gas Company completed 100 years of useful service to the town, and they desired to mark the occasion in a way which would be worthy of its importance. They had built these offices in such a manner that they hoped to encourage their customers to come with alacrity to meet their accounts, and, at the same time, to see gas appliances under the best possible conditions.

The Company had also built a lecture theatre, in which their customers could see how to use gas economically, and, in addition, the new building enabled the members of the staff to carry out their duties under ideal conditions. It was a complete product of Horsham, and on that, the occasion of the official opening ceremony, the Gas Company were being honoured, for the first time, with a visit from the Chairman and members of Horsham Urban Council.

After expressing the Directors of the Gas Company's appreciation of the visit, not only of members of the Council but also of prominent townspeople, Mr. Bennett concluded by calling upon Mr. Padwick to open the new showrooms and offices.

Mr. Padwick said that when he saw so many fellow members of Horsham Urban Council present he felt sure that they, like himself, must have been envious of the Gas Company's success during their 100 years' existence. Indeed, anyone who took an interest in Horsham at all, could not but feel delighted at the progress of the Company, of the way they had chosen to mark the occasion of their centenary, and of the excellent workmanship which was shown in that building product of Horsham. It was not for him to dilate on the excellence of either gas or electricity, since he used both in his own home, but it was for him to congratulate the Gas Company on the success which had attended their efforts during the past century. They entered Horsham in 1835, when the population was 5,500, and they had followed the town through thick and thin until its population was now over 15,000.

"As Chairman of Horsham Urban Council I also congratulate you on being able to erect such fine showrooms," Mr. Padwick concluded, "and it is with the greatest pleasure that I declare them open."

Mr. Padwick having been accorded a vote of thanks on the motion of Mr. Bennett, those present then adjourned to the lecture hall for lunch, when there were several toasts and congratulatory speeches.

The new premises at Horsham have a pleasing exterior design, a feature of which is the non-reflecting "invisible" windows. Inside all the latest examples of domestic gas appliances are tastefully arranged in attractive settings. The demonstration theatre is a particularly fine example of its kind, spacious and comfortable, and cookery lectures are to be held there regularly.

Gas Exhibition at Ipswich

Inclusion of Unusual Features

The Ipswich Gas Light Company staged some unusual features in the Public Hall recently as added attractions to the usual Cookery Demonstrations and Gas Exhibition. These features took the form of films and a sketch, which were introduced at each session.

The arrangements were jointly carried out by the Ipswich Gas Light Company and Radiation, Ltd., and a typical programme was as follows:

1. COMPERE . . Extends welcome to the audience and gives a brief talk on the importance of Gas. Introduces demonstrator and asks Miss Hamer to light the "New World" "padlocked oven" which heats up during the next part of the programme.
2. FILMS . . . (*a*) Krazy Kat cartoon.
(*b*) Romance of a Lump of Coal. (B.C.G.A. Film.)
(*c*) "What the Chefs Saw." (Radiation Film.)
3. COMPERE . . Invites Miss Hamer to draw one of the admission tickets from box (names and addresses on backs of tickets). Invites person whose name is drawn on to platform to see complete dinner inserted in "New World" oven. Lady from audience then chains and padlocks oven and returns to seat with key which she retains during the cooking period. Compere announces next item.
4. FILM . . . . How Gas is Made. (B.C.G.A. Film.)
5. COMPERE . . Announces sketch and gives details of characters, time, &c.
6. SKETCH . . . The chief item in this was the cooking of a breakfast by a male member of the staff of the Ipswich Gas Light Company. Menu consisted of boiled eggs, bread and butter, toast, marmalade, tea. Every effort was made to produce the meal with the greatest speed. Gas appliances used included a "New World" cooker (hotplate), a sink heater (kettle and egg saucepan filled from this), a refrigerator. The first performance took ten minutes, the final one six minutes. The average was about eight minutes. Light dialogue between the cook and a disabled assistant enlivened the sketch.
7. COMPERE . . Used the sketch as a peg for a sales talk. Emphasized that gas was the only fuel which would do the job in anything like the time, or with such ease. Gave brief talks on gas fires, "New World" cookers, sink heaters, refrigerators, &c. Talk only lasted about three minutes; then announced next item.
8. Cookery Demonstration and Refreshments. Lectures given by Miss Hamer, of Radiation Research Kitchen.
9. Complete dinner taken from "New World" oven.
10. Lady from audience drew tickets for kettles. Six kettles given away free at every performance.
11. Compere closed proceedings. Thanked member of audience for her assistance and presented her with a Pyrex dish. Drew attention of audience to the exhibits and invited examination.

Over 7,000 people attended the performances during the week, and unusually large numbers took advantage of the opportunity to walk round and examine the exhibits in the mornings. The B.C.G.A. films as shown under these conditions proved very popular, and the whole show was very successful and resulted in excellent business.

Liverpool Gas Exhibition

Display for Industrial Users

An exhibition has been organized by the Liverpool Gas Company of the uses of gas for industrial purposes in their showrooms at Grenville Street South, Liverpool.

Liverpool's industrialists are using gas in increasing quantities, and also in conjunction with electric plant. The exhibition reveals the power of gas for heating, drying, generating, and driving in connection with the many up-to-date machines on view. There is, for instance, a demonstration of oxy-coal gas cutting and profiling. A new type of central heating boiler with a thermal efficiency of 90%, installed in a number of large city offices, is also shown. The boiler is thermostatically controlled, and any desired water temperature can be obtained. A gas-driven electric generating machine is demonstrated. This plant is entirely automatic.

The exhibition further includes examples of general heat treatment, rivet heating, and forging furnaces; various types of drying ovens; automatic gas-fired steam boilers; natural draught burners, soldering stoves, muffle furnaces, conversion sets, heaters used for introducing hot dry air into drying and conditioning rooms; clothes-pressing machines, sugar boilers, and various types of brass-melting furnaces.

The exhibition, which will remain open for a month, has been visited by many representatives of city firms.

Parkinson Food and Folk-Lore Demonstrations on Tour

Attended with Splendid Results

The series of playlets featuring the folk-lore and dishes commonly to be met with in Czechoslovakia and Jugoslavia, organized by the Parkinson Stove Company, Ltd., in co-operation with a number of important gas undertakings and fully described in the "JOURNAL" for March 18, is continuing on tour with every success.

With the assistance of the Lichfield Gas Company, a food and folk-lore week was staged in the Wesleyan School Room, and very satisfactory interest was aroused among housewives, resulting in good audiences at each performance. In the following week these demonstrations were presented in the demonstration rooms of the Scarborough Gas Company, and a very full and appreciative audience resulted.

Continuing their tour, Miss Gwen L. Hughes and her party proceeded to Leeds, and here again real enthusiasm for this type of cookery demonstration was met with, and the Gas Department co-operated in every possible way, with the result that another successful week was recorded. The next series was given at Liverpool in the Rushworth Hall, and an audience of good proportions showed very great interest in the cooking of Czechoslovakian and Jugoslavian dishes, and the folk-songs and national dances of these two countries. The following week similar demonstrations were staged in the Eccles Town Hall, with the kind co-operation of the Salford Gas Department. Crowded attendances were the rule, and the entertainment was appreciated to the fullest extent. A good display of modern Parkinson gas appliances was on view and great interest was shown in these appliances. "Food and Folk-Lore" will continue its tour during the next two months with the co-operation of other gas undertakings.

An Investigation of Stain on Heat-Resisting Gas Globes

By W. H. Hampton, Ph.D., B.Sc., F.Inst.P.

The development of a reddish stain on heat-resisting gas globes used with high-pressure gas has been noticed from time to time. The origin of this colour has now been cleared up as a result of investigations carried out in the Research Laboratories of Chance Brothers & Co., Ltd., Glass Works, Smethwick, who are well known as manufacturers of this type of material.

Chemical analysis showed in all cases that the colour was due to the presence of reduced copper. Since the stain was not removable by hydrochloric acid but could be dissolved away by hydrofluoric acid, it follows that the stain had been burnt in at a temperature above the softening point of the glass.

It has been found possible to reproduce the mark by various methods, such as by the evaporation of a dilute solution of copper sulphate to dryness on the globe, with subsequent strong heating with a flame. It was also found possible to develop it by allowing a bunsen burner with a brass stem to "burn back" and the green coloured flame so obtained to be directed on to the globe; after a few hours' heating a pink stain was produced which was identical with the marking on the globes that had been returned for inspection.

Since there is no copper in the original glass, it is clear that this stain comes from the fittings, either due to corrosion and subsequent solution of the products of corrosion by condensed moisture which runs down on to the globe and evaporates there, or by the impact of a flame containing volatile copper compounds due to incomplete combustion in the first place.

The fact that it is possible to heat the glass so that its surface gets above the softening point, and to do this without fracture confirms the very high heat-resisting qualities which are obtainable with gas globes at the present time.

A Topical Display at Southampton

Our photograph is of a topical display designed and produced by the Parkinson Stove Company for use in the showrooms of the Southampton Gas Light and Coke Company when the liner "Queen Mary" leaves on her maiden voyage. It provides a striking link-up with the achievement of the Gas Industry.

Simplified Soldering

Fluxite Products

There are few trades or industries to-day which do not carry out soldering in one process or another, and in this connection a few notes on the latest "Fluxite" products may be of interest.

This material, which is marketed by Fluxite, Ltd., of Dragon Works, Bermondsey Street, S.E. 1, comprises a paste flux with which even dirty metals can be soldered and tinned. It is stated that it does not "poison" the solder or corrode the metal and can be used on sensitive apparatus. The numerous other advantages claimed for "Fluxite" include the jointing of lead without solder, and the running of white metal bearings without tinning the bearing. Being in the form of paste it adheres to the work, while, it cannot be spilt, being carried safely in the pocket or tool kit.

The firm supply a very useful and compact soldering set for household use and for the tool kit of motor-cars and cycles. This set enables anyone to do ordinary soldering work, and contains a special "small space" soldering iron with a non-heating metal handle, pocket soldering lamp, &c. Another useful soldering accessory manufactured by the firm is the "Fluxite" gun, which projects the paste where it is wanted like a grease gun.

In addition to its use as a flux for soft soldering, "Fluxite" can be utilized for case-hardening steel articles, and also for hardening and tempering tools. By its use these processes are carried out cleanly and expeditiously, and the result is claimed to be a beautiful, bright, glass-hard surface, free from scale and uneven patches, and deeper than by other methods.

Athletic and Social

Cardiff Co-Partnership Meeting: Bonus of 6⅜%.

A meeting of the Co-Partnership Committee was held on March 26, 1936, at which Mr. Lawrence G. Williams (Chairman of Directors) presided. He was supported by Mr. Robert H. Williams (Deputy-Chairman), Mr. James Miles (Director), Mr. H. D. Madden (Engineer and Manager), Mr. R. J. Auckland (Secretary), and Mr. B. J. Bell (District Superintendent). The co-partners' elected representatives present were as follows: Messrs. J. E. Jenkins (Staff), A. E. Hall and J. G. Lewis (Grangetown Works), A. Whitlock and O. Wilcox (Bute Terrace), and H. S. Brown (Mains and Services).

In presenting the Statement of Accounts and Committee Report to the meeting, the Chairman said: "I am pleased to say the Directors have placed to the credit of the Co-Partnership Fund the sum of £6,769, and this sum, together with the balance brought forward from the previous account, will enable a division based on the wages and salaries of co-partners equal to 6⅜%. I have to announce, therefore, that the distribution of bonus will be at this rate. You will probably notice that the rate is slightly less than that for last year."

It was resolved that the Company's ordinary stock which had been acquired for the purpose should be divided among the co-partners at the average price of £132 19s. for every £100. Mr. J. G. Lewis expressed satisfaction at this price, which was considerably less than the price at which the stock had been quoted during the past year. He took the opportunity also of expressing thanks for the consideration that had been given by the Directors to withdrawals from the co-partnership fund in cases of need. The requirements of co-partners had been generously met and had provided great satisfaction to the co-partners.

Mr. Wilfrid Jones was re-elected as auditor of the co-partnership accounts for the ensuing year, and a vote of thanks was accorded to him for his past services.

The Engineer and Manager, Mr. H. D. Madden, spoke of the work which had been carried out during the year with special reference to the successful campaign for the sale of hot water appliances and also of the inauguration of the Women's Gas Council. During the ensuing year it was intended to continue the hot water appliances campaign and also to put forward great efforts for the sale of gas-operated refrigerators in addition to other appliances.

A vote of thanks to the Chairman was proposed by Mr. H. S. Brown, and seconded by Mr. J. E. Jenkins, and carried unanimously.

Cheltenham Company's Annual Dinner.

The Annual Dinner of the Cheltenham and District Gas Company was held on Friday evening, March 27, when Mr. A. L. Morris, Accountant and Commercial Manager, took the chair.

For the first time district representatives as well as Cheltenham employees were present. There was an attendance of nearly 350, representing all departments and branches, including those of Tewkesbury, Broadway, Chipping Campden, Pershore, and Bidford-on-Avon.

Mr. Morris, proposing the toast of "Our Guests," said, "I would like to tender our sincere thanks to Mr. Sidney Wood, our Chairman, and our other Directors for enabling us once again to meet in these happy circumstances this evening. I am sure that such functions as these go far towards fostering the enthusiasm and good spirits which make for progress. We are employees of an Undertaking of very considerable size. The Company has an area of 359 square miles, with 220 miles of supply mains, and 23,500 consumers. The furthest point of supply for gas manufactured in Gloucester Road, Cheltenham, is 31 miles away.

"Cheltenham is now one of a group of thirty Companies, the Severn Valley Group, of which Stroud and Gloucester are others. In the old days the relationship between the three companies was distant. Now they are in close contact and there is a feeling of happy comradeship."

Mr. T. H. Woodcock, Engineer and Works Manager of the Stroud Company, responded.

Those present included: The Chairman, Mr. A. L. Morris; Mr. L. E. Twycross, M.Inst.Gas E., Engineer and Works Manager; Mr. T. H. Woodcock; Mr. W. R. Payne, Secretary, The Stroud Gas Company; Mr. H. A. Thomas, Director; Mr. H. S. Boyes, Assistant Engineer; Mr. W. Wright, Accountant; Mr. A. G. Holtam, Distribution Superintendent; Mr. W. Walker, The Severn Valley Gas Corporation; Mr. W. A. Chard, Gloucester Gas Company; and Mr. W. Barber, Stroud Gas Company.

Chester Co-Partnership Meeting: A 6½% Bonus.

The success of the Co-Partnership Scheme of the Chester United Gas Company was evidenced at the Annual Meeting of Co-Partners held at the works on March 23, the Chairman of the Company, Mr. R. Farmer, presiding. Mr. Farmer was supported by Mr. T. Gibbons Frost, Mr. J. T. Golder, Mr. W. Cullimore, Mr. Humphrey Gamon, and Mr. Ambrose Roberts (Directors), Mr. H. Hopkinson (Secretary), and Mr. J. H. Noble (Engineer).

The annual report of the committee stated: The amount allocated by the Directors to the Co-Partnership Fund is £1,498. The rate of bonus will be, as in previous years, 6½%. During the year £510 of the Company's stock has been purchased by co-partners.

The Chairman, at the outset, referred to the death of Sir John Frost. "Our original profit sharing scheme," the Chairman added, "was instituted in 1901, and Sir John joined the Company's Board in 1904. He had, therefore, seen the development of the scheme from its early days." As a tribute to his memory, all stood in silence.

Moving the adoption of the report and accounts, Mr. Farmer said "The amount allocated to the co-partnership fund, £1,498, enables the bonus to be maintained at £6½%. Members have deposited £112 and interest credited in your pass books totals to £150. Withdrawals amount to £962. This is a large figure. It includes, however, £85 to retired employees, over £300 towards house purchase, and £80 for purchase of Company's stock, other than that purchased from your trustees. The withdrawals for ordinary purposes have, therefore, been £480. We should like to see the withdrawals reduced. I know that in times of sickness and other trouble a withdrawal can be of substantial assistance; but otherwise the bonus should be left untouched or invested in stock. Those who have acted wisely in this respect have ample evidence of the real lasting benefit of the co-partnership scheme. I am, personally, extremely glad to know that 114 employees hold stock in the Company, and that the aggregate amount held is over £8,200." In conclusion, Mr. Farmer referred to the retirement on pension during the year of Mr. Arthur Eaton after 36 years' service. Since the close of the year they had lost three co-partner employees through death—Mr. James Johnson, Mr. Walter Turner, and Mr. William Johnson. Mr. J. Barker, seconding, said he hoped they all realized the spirit that prevailed on the Board of Directors, and the fact that those members they had lost were not forgotten tended to bring a better spirit in the co-partnership movement.

The motion having been heartily carried, on the proposition of Mr. J. Thompson, seconded by Mr. H. Lewis, the auditor and officials were thanked for their services during the year. Mr. T. L. Jones responded.

The Chairman was thanked, on the motion of Mr. M. D. McCaskell, seconded by Mr. W. Caton. Mr. Farmer briefly responded.

"Stellite" Purchase Connah's Quay

Bulk Supply to Consumers

The Connah's Quay Gas Company, Ltd., which supplies gas and water in the populous Deeside area of Flintshire, has been purchased by Stellite, Ltd., a firm of patent fuel manufacturers, which established itself about two years ago at Queensferry.

During the sixty years of its existence, the Connah's Quay Gas Company had been a highly successful Undertaking, and had only two Managers during its lifetime. Mr. John Forber was the first to hold the position, and in 1904 he was succeeded by his son, Mr. Arthur Forber, who has held the post up to the present time.

Messrs. Stellite, Ltd., will close the Works later and transfer all the employees from Connah's Quay to Queensferry. Owing to the increasing demand for patent smokeless fuel, considerable extensions are going on at Queensferry, and gas of 650 B.Th.U. is one of the by-products. The Company intend to supply gas by high-pressure main from their Works throughout the whole of the Connah's Quay area.

Although the workers of the Connah's Quay Gas Company are to be transferred to Queensferry as a result of the purchase of the Company by Stellite, Ltd., we understand that the Company will remain in existence as the Statutory Gas Authority in the area, and will continue to be responsible for the distribution of gas.

An American View of the Sliding Scale*

"Accordingly producers are urging the imposition of a reasonable maximum dividend and price with certain safeguards; thus allowing companies to carry on their undertakings with 'ordinary commercial prudence.'"

Well! Well! Is this indeed the attitude of the British Gas Industry towards the sliding scale? It is, according to Dr. Irvin Bussing in his book "Public Utility and the So-called Sliding Scale." And among those upon whose assistance the author says he has had to rely to a considerable extent for information are the names of Mr. W. J. Smith, Secretary of the National Gas Council, and Mr. Leslie Stemp. Can this be their opinion? For they ought to know. But how is it to be reconciled with the statement made in the introductory chapter that "the scheme is being extended as non-sliding scale companies come before Parliament in quest of additional corporate powers?"

It looks as if the author had misconstrued the information received, and is under the impression that Parliament imposes the sliding scale against the will of the companies applying for powers. If so, he is mistaken. During the last five years every company that has applied to change the system under which it was working has desired to change from a maximum dividend to some form of sliding scale, and in not one instance has an application been made to substitute a maximum for a sliding scale. Perhaps in the term "reasonable maximum dividend" the emphasis is intended to be on the word "reasonable." For it is probably true to say, as does the author, that undertakers maintain that competition from electricity and oil serves to regulate the price of gas.

There are large numbers of companies with standard prices fixed at a time when the general level of costs was much higher, and which have not since been revised. It may be that the authorized dividends of many of these companies are in consequence higher than commercial considerations will permit of being distributed. If what is meant by a reasonable maximum is one having this kind of relation to profits, it might possibly be popular in the Industry. Outside the Industry, it is unlikely that the word "reasonable" applied to such a maximum would be considered the proper adjective.

It is not, however, by any means certain that, even when the authorized dividend under a sliding scale is out of reach, the actual dividend paid will be limited only by commercial considerations, if by these is meant limited by the profit that can be made at a price of gas competitive with electricity and oil. There is always in the background the chance that the local authority will apply to the Board of Trade for a revision of the standard price. Directors do not like to have to reduce a dividend once reached, and so frequently, indeed more often than not, they limit the dividend to what they think would continue to be authorized even after the price had been revised. On the other hand, there are companies paying a much higher dividend than could possibly remain authorized after the standard price had been revised, and this would suggest that commercial considerations will not in all cases keep dividends as low as will statutory restrictions.

The sliding scale is defined by the author as "any form of regulation in which the profit allowed increases or decreases in proportion as prices decrease or increase." He describes the various systems conforming to this definition that have been devised on both sides of the Atlantic, and gives much historical information of their application to specific undertakings supplying gas and electricity. There is much illuminating comment on the various aspects of public utility regulation, and incidentally references to cognate matters such as the difficulties that may arise when a controlling interest in a public utility is held by another company.

Those interested in this problem should study the Boston case. The Commissioners who investigated the affairs of the gas companies supplying this city said in their report of 1916: "If profits can reach the stockholders of a gas company under the sliding scale by any other means than through its dividends, the basis of control is impaired if not wholly destroyed." And the author points out that "A process which permits insiders to divert potential net earnings into their own pockets under the guise of operation expenses, directs the company's attention away from earnings of the operating company and thus interferes with or renders unnecessary a reduction of price to the public. By means of such practices as those here revealed, insiders are able to reap where they have not sown, and arrogate profits to themselves which the law intended they should receive only in return for reducing operating expenses and lowering prices to consumers." But always impartial, the author says in a note to the foregoing: "A holding company relationship honestly conceived and maintained is not without advantage;" and he explains why.

The book is, of course, written from the American point of view, and the form of sliding scale in the U.S.A. is very different from that in use in this country. It appears to be the usual practice there not to regulate the capital arrangements of the company or to limit dividends, but to secure that after a certain profit has been made the price charged must be reduced so that eventually the revenue will only be sufficient to yield the standard profit.

Take, for instance, the system applied to the company supplying electricity in Washington, D.C. The company is permitted to make sufficient profit to pay 7% on an agreed value of the undertaking. If the profit amounts to more than this, prices must be reduced to absorb a certain proportion of the difference. It follows that with an undertaking with a stationary output the price charged would gradually be reduced until the profit was equal to 7% on the rate base, as the capital value attributed to the undertaking is called. This is only a rough description of the principle on which the system is devised, but it shows the difference between the sliding scale arrangements here and in the U.S.A. The average annual earnings of this company during the last five years have been over 60% on the par value of the shares, yet in eight years from being among the highest in the country the electric prices became among the lowest. At first sight this would seem to be a signal testimonial to the sliding scale. The author seems to be doubtful, for he remarks after an examination of the conditions in Washington that "Not only is the price of electricity among the lowest in the U.S.A., but so also is the price of gas, although the gas company does not work under a sliding scale."

It would be interesting to know how the prices came down. Was the price of gas low when the price of electricity was high, or were they both high together and came down together? If the latter, then the sliding scale applied to electricity may have brought down the price of this commodity and the pressure of competition had a similar effect on the price of gas. So that the sliding scale applied to electricity lowered the price of both commodities.

The last chapter is devoted to an examination of the weaknesses of sliding scales and the principles upon which they should be constructed, and it seems to be the author's opinion that the divisible profit should be increased beyond the standard rate only when such increase is earned. He makes the interesting suggestion that this improved income, being the result of good management, should go not to the shareholders, but mainly "to those directly engaged in production—employees from the Chairman down." There is a great deal to be said for this view, although it is not likely to appeal to shareholders, and the 50-50 division between employee and shareholder as provided for in most basic price provisions is perhaps a reasonable compromise.

Great importance is attributed to the distinction between earned and unearned income, and the devision of a suitable technique is said to be a "challenge to engineers, accountants, and economists." Probably with the sliding scale system in the U.S.A. this matter is of fundamental importance. The systems in use on this side of the water do not depend for their efficiency on a very accurate distinction.

The advantage to the consumer of a sliding scale depends upon whether it does or does not ensure lower prices than other systems of regulation. It may be suggested that, from this point of view, the important problem is not so much to determine what part of supernormal income is due to supernormal management as to devise a scale that will ensure that the largest possible share of supernormal income, either potential or realized, shall be devoted to the reduction of prices, leaving to the company the smallest share that will ensure their best efforts to make the supernormal income as large as possible. This would seem to require the services of a psychologist as well as those of "engineers, accountants, and economists."

"ANON."

* By Irvin Bussing, Ph.D. Published by the Columbia University Press. $2.75. London: P. S. King & Son, Ltd., 14, Great Smith Street, S.W. 1.

LONG SERVICE TO THE GAS INDUSTRY

A number of firms of long standing on the contracting and manufacturing side of the Industry have collaborated with the "JOURNAL" in the production of a series of articles, under the above title.

R. & J. Dempster, Ltd.

Although the firm of R. & J. Dempster, Ltd., of Manchester, dates from 1885, the zeal and ability that formed and has directed it had been developed elsewhere, and the real origin must be traced back to 1855. The founder, Mr. Robert Dempster, like a good Scotsman, built up slowly but surely in those days a sound reputation, founded upon his practical knowledge of the management of gas-works, and his skill as a consulting gas engineer. The firm of Dempster established a reputation for reliable and expeditious work, and sound business methods in those days kept the workshops fully employed.

Mr. Dempster was fortunate in having the assistance of Mr. R. A. Hepworth, who possessed not only skill as an engineer, but considerable ability in works supervision and control. He was appointed General Manager, and two sons, Mr. R. Dempster, Junr., and Mr. John Dempster, after passing through the various shops, were later added to the Staff—reaping in after years the benefit of the thorough training they had received.

Mr. John Dempster's inventive frame of mind was directed to the recovery of by-products from blast furnaces —at that time operating with coal—and he succeeded in effecting improvement in the objectionable atmospheric conditions obtaining. An extensive contract was entered into under his patents, and the results were guaranteed financially. Fortune favoured the firm, and the plant worked satisfactorily from its inception.

In 1885, Robert Dempster, Junr., along with his brother John, purchased the Steel Plant Works at Newton Heath, Manchester, and equipped them with all the latest available machinery for the manufacture of gas plant. They were accompanied by Mr. R. A. Hepworth and the leading foreman, along with many of the staff.

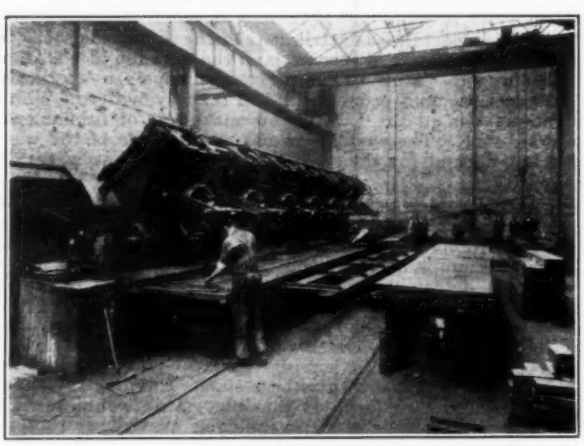
It is interesting to note that the old "Gas Institute" meeting was held in Manchester the same year, Thomas Newbigging, M.Inst.C.E., being the President. To quote the "JOURNAL" of that time: "Many members availed themselves of the courtesy extended to the Institute by the several firms who kindly allowed their names to be entered in the list of works open for inspection. The spacious and complete set of plant recently put down at Newton Heath by Messrs. R. & J. Dempster, for the manufacture of all kinds of plant for gas-works, was much admired, and pronounced to be one of the features of the visit to Manchester." The members paid a visit to the new Gas Plant Works, and expressed their admiration of the general lay-out and equipment, and also surprise at the extensive spaces where work could be carried out under cover.

In 1893 the firm was turned into a private limited company, and was fortunately able to retain the services and assistance of those who had so materially contributed to the sound business that had been already established. Messrs. R. & J. Dempster still further exploited the recovery of by-products, and an extensive plant was erected at Messrs. Wm. Dixons, Glasgow, situated in a busy district which thereafter benefited by living under much improved atmospheric conditions. At many other blast furnace works the Dempster process was applied, and in one instance a works was purchased in order to reap the benefit now assured. The change-over, however, from coal to coke at such blast furnace works closed down a very successful line of business.

Scrubbers.

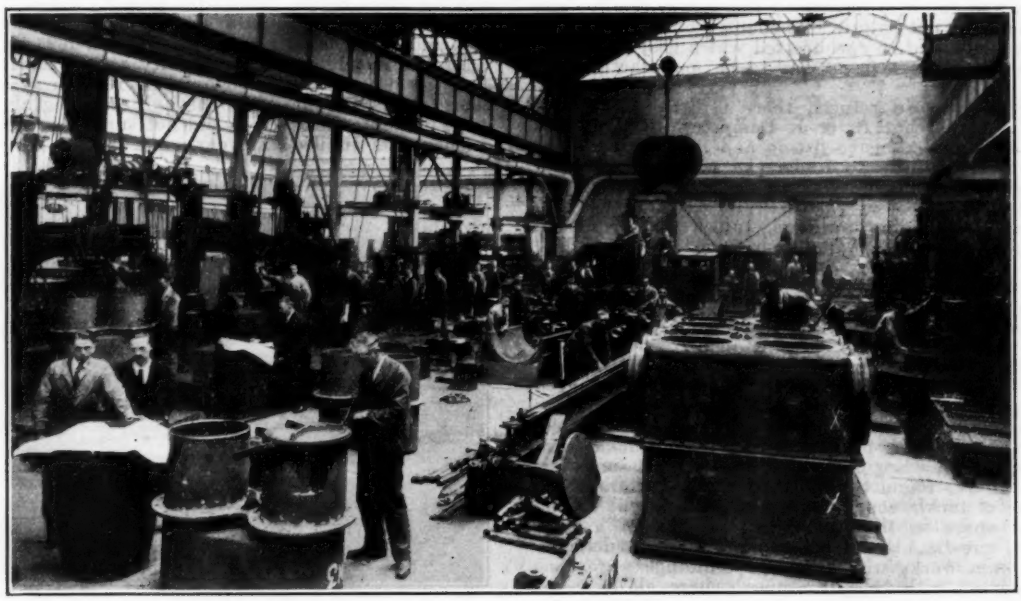
In passing it is interesting to note that in some of these plants the scrubbers used were in sets of four, 120 ft. high by 16 ft. diameter, and required upwards of 400 tons of timber filling, while each condenser contained 250 tubes, 40 ft. long and often of 24 in. diameter.

The tower scrubber was a prominent feature of the firm's



Waterless Gasholder Section, Bending Machine.

Waterless Gasholder Template Floor.



The Fitting Shop, Heavy Assembly Bay.

early activities—ammoniacal liquor being valuable for the manufacture of sulphate of ammonia which was sold in those days for about £20 a ton. If, too, the scrubbers were operated in accordance with the manufacturers' directions, the work of the purifiers was reduced, for those were the days of lime purification. It is from early specialization in this type of plant that the firm derived its well known telegraphic address of "Scrubber."

Before long a London office was opened with a Resident Engineering Representative, and many orders were secured for the delivery and equipment of complete gas-works in many parts of the world. Contact was also made in this way between this Northern firm and gas-works in the South.

Spirally Guided Holders.

Mr. W. Gadd, M.I.M.E., the inventor of the spirally guided gasholder, was a Manchester engineer, and after some early vicissitudes R. & J. Dempster, Ltd., secured the sole right of manufacture of this type of holder, and under their guidance and control it eventually overcame professional and trade prejudice, and from that time forward, largely owing to the improvements they introduced, it has continued to find orders for the firm, and employment for many specially trained workmen.

The firm have erected the largest spiral holder in the world, and the "Bearscot" specialities are a recognized *sine quâ non* on holders of this type. The "rope-guided" gasholder of forty years ago actually served to demonstrate the advantages of the spiral rather than to act as a severe competitor.

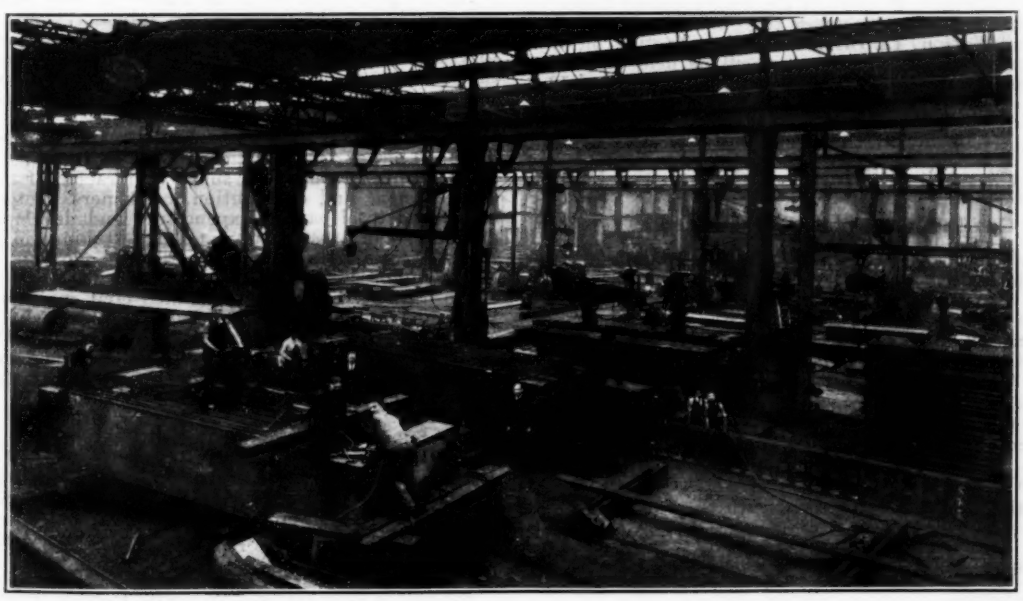
Waterless Storage.

As with the spiral, so with the M.A.N. waterless holder of recent years. R. & J. Dempster, Ltd., were again the prime movers in popularizing this new type of storage in the British Isles and Colonies, and of the 40 holders erected by British licensees, 22 have been constructed by them, including the largest in this country—that of 8 millions capacity at Southall. They have also, incidentally, made the smallest M.A.N. waterless holder, this being one erected some miles from the works of the Brighton Gas Company of Australia for the purpose of supplying gas to an outdistrict, and the Engineer is enthusiastic regarding its satisfactory working and service.

For the fabrication of waterless holders, a new shop was built and two new special machines were installed, these being the plate bending machine and the milling machine. It is interesting to note that these machines are the only examples of their kind to be found in the British Isles.

Plant of All Types.

In the early years of the century, the manufacturing rights were secured from Mr. Carl Dellwik for his blue



General Assembly Department.

water gas, and the firm developed this commercially, and erected the plant not only in this country but also abroad. Later it was adapted to carburetted water gas, and made applicable for either type of gas to be manufactured at will.

Apart from vertical retorts, there is little plant in a modern gas-works that R. & J. Dempster, Ltd., do not manufacture. An extensive fitting and machine shop enables them successfully to undertake the production of condensers and washers of all types, also steam engines and exhausters, together with valves, while cast-iron work of various kinds, including purifiers, tanks, plates, special pipes, and valves are manufactured in an up-to-date foundry.

During the last few years, the boiler shop, fitting shop, pattern making and paint shops, and template floors have been entirely rebuilt, and in view of modern tendencies extensive welding plant has been installed. The constructional sheds are 360 ft. long with a span of 63 ft. Overhead electric cranes capable of lifting 10 tons travel the length of each bay to facilitate the handling of material.

As the changes in design of gas plant have taken place, so the form and type of the necessary erection tackle have changed also, and when the works were rebuilt some few years ago, it was found that the extra space required for the storage of tackle could not be afforded except at the expense of space in the workshops. A plot of ground covering 2½ acres was therefore secured some little distance from the main works whereon large buildings were constructed, served with electric cranes, where all types of erecting equipment from spanners, ropes, and blocks to compressors and erection cranes can be stored under cover. Machinery for repair work was installed, and a large staff is continually employed in overhaul, inspection, and replacement work on tackle.

War Service.

In the Great War, the Government discovered that R. & J. Dempster were one of the few British firms who could supply the hydrogen plants required for the Royal Naval Air Force, and they were at once "badged" and the workmen earmarked for this important work, upon which the firm were fully employed up to the Armistice. They also erected these plants in France.

During the War years, also, they provided benzole and toluol, along with oleum, celulose, synthetic ammonia, concentrated liquor, and munition gas plants, as well as parts of appliances for assembly by other firms.

Management and Staff.

To-day, Mr. Charles Dempster is Chairman of the firm, and like his father, he went through the various workshops and the office before joining the Board. Upon the sudden death of his father in 1916, he was released from war service and succeeded his uncle who died in 1925.

Mr. R. A. Hepworth, after fifty years' service, passed away in 1929. Even when living in retirement he kept in close touch with the works through retaining his Directorship, but unfortunately he did not survive to see the firm celebrate its Jubilee last year.

Messrs. Robert and John Dempster.

Mr. H. S. Knight was for some years General Manager, and under his direction the works were extended and reconstructed after the War. His unexpected demise was a great loss. Mr. J. Winson Scott now occupies the position of Managing Director.

On the social and welfare side the firm has spent considerable time and money. During the works reconstruction a large canteen was built, including staff and workmen's mess rooms, up-to-date all-gas kitchens, and large recreation rooms where whist drives, concerts, and dances can be held. A sports ground was also purchased, and many keenly contested cricket, football, bowling, and tennis matches have taken place either between the various departments or against other local teams.

The Robert Dempster Benevolent Fund financially assists those employees of the firm who have, through accident, illness, or old age, encountered "hard times," and this fund perpetuates the memory of one of the founders of the firm.

The National Benzole Association

Ninth Plenary Meeting

The Ninth Plenary Meeting of the International Conference of Benzole Producers, under the Chairmanship of Sir David Milne-Watson, LL.D., D.L., and a Meeting of the International Road Tar Conference will be held at Gleneagles Hotel, Perthshire, Scotland, on June 10, 11, and 12, 1936.

British Chemical Plant Exhibition, 1936

Gas Industry Well Represented

With the exception of one small stand, the whole of the space at the British Chemical Plant Exhibition, 1936, has now been taken. The Exhibition is being held at the Central Hall, Westminster, S.W. 1, at the same time and in the same building as the International Chemical Engineering Congress of the World Power Conference—*i.e.*, from June 22-27 next.

The Exhibition will be opened at 11 a.m. on Monday, June 22, in the Great Hall of the Central Hall, and the official opening will be followed by an official tour of the Exhibition and an Inaugural Luncheon at the Hotel Victoria, Northumberland Avenue.

Among the exhibitors connected with the Gas Industry we note the following:

Ashmore, Benson, Pease, & Co., Ltd.
British Gas Federation.
The British Oxygen Co., Ltd.
Thomas Broadbent & Sons, Ltd.
Cannon Iron Foundries, Ltd.
Manesty Machines, Ltd.
Siebe, Gorman, & Co., Ltd.

The Water Engineer's Handbook and Directory—1936*

That "good wine needs no bush" is very true no one will doubt, but the value of the annual review of such a publication as the Water Engineer's Handbook and Directory finds its apology not in the continued acceptance of that fact but in catering for the changing personnel of the water supply industry and the amendments, additions, and revisions that appear from year to year.

As last year the Directory of Water Undertakings takes pride of place. This section tabulates the chief officers, areas supplied, sources of supply, character of the water, its treatment and distribution, consumers' meters, water rates, and total capital expenditure and developments in progress or in prospect of water undertakings in England, Wales, Scotland, and Ireland. There follow an index of water engineers, list of catchment boards, and drainage authorities. The panel of qualified civil engineers constituted under the Reservoirs (Safety Provisions) Act, 1930, is also detailed. Mr. John Glasspole, M.Sc., Ph.D., writes on the Rainfall of 1935, while Mr. E. Copeland Snelgrove, M.I.Struct.E., M.Soc.C.E. (France), deals with Compensation Problems.

A Review of Case and Statute Law of 1935 as affecting Water Supply Undertakings has been contributed by Mr. H. T. Seymour, F.R.Econ.S., A.C.I.S., A.L.A.A. Other sections deal with algal growths, list of British Standard Specifications relating to Water Supply, Water Supply in 1935, Hydraulic Data and Formulæ, an overseas section, Institution and Government Departments, and Associations and Societies.

* Published by *Water and Water Engineering*, 30 and 31, Furnival Street, Holborn, E.C. 4. Price, 8s. 6d.

THE RESTRICTED TREATMENT OF Benzoles with Sulphuric Acid before Stabilization with Gum-Inhibitors

by
W. H. HOFFERT, G. CLAXTON, and E. G. HANCOCK, of the National Benzole Company, Ltd.

(*Concluded from p.* 105.)

(B) Removal of Sulphur.

It is now known that the colour of many benzoles can be removed completely with only small quantities of acid of 78 to 80% strength. These amounts and strengths of acid, however, are not always sufficient to reduce the thiophen content of the benzole sufficiently to bring the total sulphur within the limit of 0·4% by weight required by the N.B.A. Specification.

Further experiments, therefore, were carried out to see whether any concentration and strength of acid preferentially attacks thiophen and its derivatives.

(1) *Effect of the Quantity and Strength of Sulphuric Acid.*

In each experiment, 200 millilitres of benzole was treated with the acid in the small rotary washer for 30 minutes. After standing for 15 minutes the spent acid was run off and the benzole agitated with approximately 5% by volume of water for 5 minutes and allowed to settle. The benzole was next agitated for 15 minutes with 5% by volume of 20% caustic soda, and finally with 5% by volume of water. The benzole was then run off, measured, and redistilled to 160° C. through a 6-bulb Young column. Special precautions were taken to avoid errors due to the formation of emulsions. The total sulphur[20] and sulphur present as carbon disulphide[21] were estimated in the distillate, the difference being assumed to be chiefly thiophen sulphur.

The results of these tests, using acid of strengths varying between 70·9 and 98%, and amounts up to 7% by volume are shown in Table IV., while in fig. 1 (A) the amount of sulphur present as thiophen in the distillate has been plotted against the yield for all amounts and concentrations of acid, and in fig. 1 (B) it has been plotted against the strength of acid.

As a result of these experiments the important general conclusion has been drawn that the same yield of benzole will be obtained for a given removal of thiophen irrespective of the concentration and the amount of acid used. Thus, 5% of 77·9% acid produced a 92% yield of benzole containing 0·38% of sulphur as thiophen. Practically the same yield and sulphur content was obtained by 1% of 88·5% acid. Hence, the most suitable strength and amount of acid for removing sulphur will be governed by the cost of acid and by other considerations that vary according to the character of the benzole. Small amounts of strong acid, owing to neutral ester formation, are more liable to lead to the production of sulphur dioxide during distillation than larger amounts of weaker acid. Not only does sulphonation, when using strong acid, tend to cause emulsification, but larger quantities of acid usually separate more easily, owing to the fact that there is a greater chance of dissolving out the resinous polymers from the benzole layer. With too great a dilution, however, the polymers remain in the benzole, as in the Ufer process. Thus, it is clear that there is an optimum concentration that can only be determined by experience for each benzole.

Another important conclusion is that even with amounts of acid up to 7% by volume it is impossible to reduce the thiophen sulphur content of a benzole to a low figure without using fairly strong acid. Thus, 7% of B.O.V. (77%) only reduced the thiophen sulphur from 0·52 to about 0·36% by weight (fig. 1 (B)). In a further experiment, in which the benzole was given six washes each with 3% by volume of 65% sulphuric acid, the sulphur present as thiophen was only reduced from 0·52 to 0·48% by weight, the yield being 93% (*cf.* fig. 1 (A)). The rapid increase in the effectiveness of the acid between 80 and 83% strength should be noted. The different shape of the curve for 1% acid is probably to be explained by the presence of the pyridine bases and possibly also to the extensive dilution of this small volume of acid with polymers.

With regard to cost, it is clear that even allowing for the lower price of B.O.V. (77%), it is cheaper to use small amounts of strong acid (95%) rather than large amounts of B.O.V. The limit is set, however, by the efficiency with which the works' washer will handle small quantities, and the other incidental difficulties indicated above.

The rapid fall in sulphur content (fig. 1 (A)) ceases when the yield of benzole is reduced to 90%. This point corresponds approximately with the complete removal of

[20] Claxton, Hancock, and Hoffert, Gas J., 1932, **199**, 94.
[21] Hoffert, Claxton, and Hancock, J.S.C.I., 1935, **54**, 239.

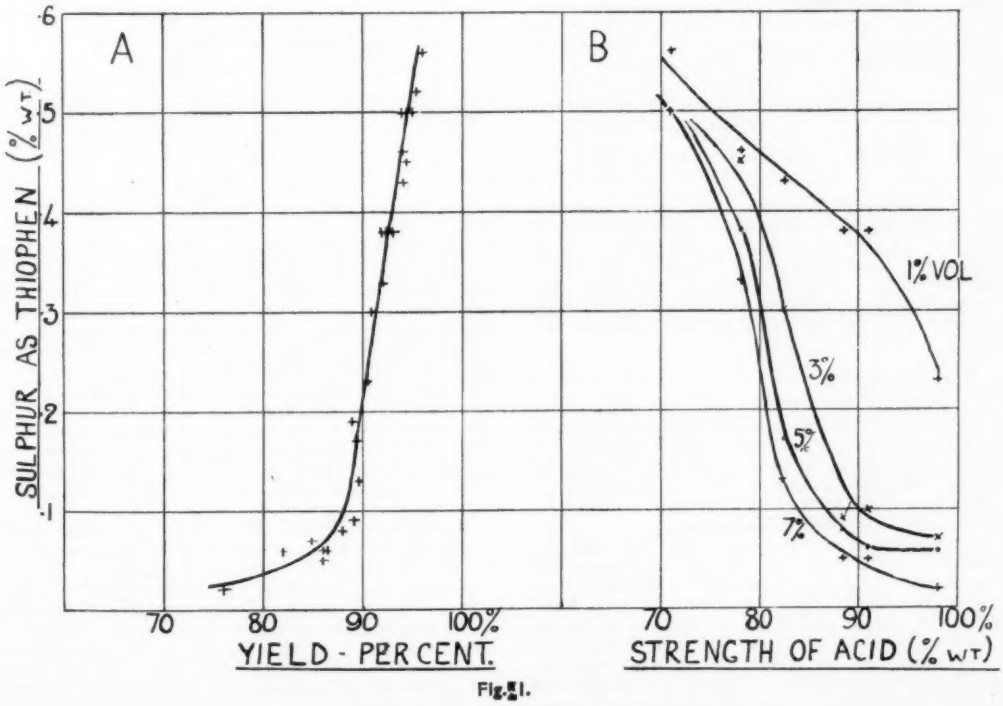


Fig. 1.

TABLE IV.—*Effect of Sulphuric Acid on the Yield and Total Sulphur Content of Benzole.*

Benzole—Mixed Crudes containing Traces of Pyridine Bases.

Quantity of Acid (%/Vol.).	Strength of Acid (%/Wt.).	Washing Loss (%/Vol.).	Yield (%/Vol.).	Total Sulphur (%/Wt.).	Sulphur as CS_2 (%/Wt.).	Sulphur as Thiophen (%/Wt.).	Sulphur as Thiophen Removed (%/Wt.).
No acid	..	..	95·5	0·86	0·34	0·52	..
1	98·0	1·0	90·5	0·60	0·37	0·23	0·29
3	98·0	5·5	85·0	0·43	0·36	0·07	0·45
5	98·0	7·0	82·0	0·41	0·35	0·06	0·46
7	98·0	15·0	76·0	0·40	0·38	0·02	0·50
1	91·0	2·5	93·0	0·68	0·30	0·38	0·14
3	91·0	2·0	89·0	0·45	0·35	0·10	0·42
5	91·0	4·0	86·5	0·42	0·36	0·06	0·46
7	91·0	4·5	86·0	0·42	0·37	0·05	0·47
1	88·5	2·0	92·5	0·73	0·35	0·38	0·14
3	88·5	3·0	89·0	0·45	0·36	0·09	0·43
5	88·5	2·5	88·0	0·43	0·35	0·08	0·44
7	88·5	4·0	86·0	0·40	0·35	0·05	0·47
1	82·3	1·5	94·0	0·78	0·35	0·43	0·09
3	82·3	3·0	91·0	0·65	0·35	0·30	0·22
5	82·3	3·0	89·5	0·52	0·36	0·17	0·35
7	82·3	2·5	89·75	0·45	0·32	0·13	0·39
1	77·9	0·75	94·0	0·80	0·34	0·46	0·06
3	77·9	2·0	94·5	0·77	0·32	0·45	0·07
5	77·9	1·5	92·0	0·66	0·28	0·38	0·14
7	77·9	2·5	92·0	0·61	0·28	0·33	0·19
1	70·9	1·0	96·0	0·88	0·32	0·56	..
3	70·9	6·0	95·0	0·82	0·32	0·50	0·02
5	70·9	6·5	94·5	0·81	0·31	0·50	0·02
7	70·9	1·0	94·0	0·82	0·32	0·50	0·02

NOTES.—1. During the tests, the CS_2 content of the once-run benzole redistilled to 160° C. fell from 0·34 to 0·26% by wt. as S.
2. Unsaturateds in once-run benzole (loss to 5% of 95% H_2SO_4) = 5%.
3. Specific gravity of once-run benzole = 0·857 at 60° F.

the unsaturated compounds, and it appears, therefore, that the ease of removal of the thiophen is governed to a large extent by the presence of unsaturateds. This is in agreement with Kruber's conclusion that condensation products are formed between the thiophen and certain unsaturated hydrocarbons.[3] After this point had been reached, the sulphur can be further reduced, although sulphonation of the aromatic compounds now occurs. Further tests on many different benzoles have given similar results (*e.g.*, figs. 2 and 3).

This relation between the ease of removal of thiophen and the presence of unsaturated compounds was supported by further experiments in which benzene solutions of thiophen were washed with sulphuric acid, either alone or in the presence of amylene. In the absence of the unsaturated compound very little action took place until the strength of the acid was increased above 90%, and even 3% by volume of 94% acid only reduced 0·45% of thiophen sulphur to 0·30%. In the presence of amylene, however, 3% by volume of 90% strength reduced 0·45% of thiophen to figures varying between 0·18 and 0·32%. This effect was not due to the enhanced temperatures produced, when using sulphuric acid in presence of amylene, since similar results were obtained when the temperature was prevented from rising appreciably by water-jacketing the washer.

(2) *Other Factors Influencing the Removal of Sulphur by Sulphuric Acid.*

The general relationship between yield and thiophen content obviously provides an extremely useful method of following the effect of variation in other conditions, such as temperature, time of agitation, &c. Thus, having established the sulphur-yield curve for normal washing conditions, any condition that produced a preferential removal of thiophen would give results lying to the right of the normal curve.

(*a*) *Effect of Time of Contact.*

The time of contact of the benzole with the acid varies considerably on different works, considerations of convenience and throughput on the plant usually being the governing factors. Further, there are large differences in the efficiencies of different washers. It was necessary to know the effect of these factors, therefore, in order to translate our results to works-scale practice.

Preliminary experiments showed that the yield and the sulphur content fell rapidly during the first half-hour, but after this time the reaction slowed down considerably until finally the reaction ceased. The important factor, however, was that the yield and sulphur content obtained under very varying conditions always fell within the limits of error on the standard curve for 30 minutes' stirring. This effect is illustrated in fig. 2, in which the yields and thiophen sulphur for different times of stirring and varying strengths and quantities of acid are plotted on one graph.

In subsequent experiments a washing time of 30 minutes was used, although in view of the efficient nature of the laboratory stirrer, for a particular quantity and strength of acid these results would require a much longer time in the average works' washer.

(*b*) *Effect of Temperature.*

Experiments were carried out, using amounts and strengths of acid, at room temperature, at 0° C. and at − 5° C., in order to determine whether the sulphuric acid acts selectively on thiophen at lower temperatures. The same washer as in the previous experiments was used, an external jacket being provided which could be filled with water, ice, or a freezing mixture.

It was found that the greatest rise in temperature of the benzole took place within the first 5 minutes, after which the temperature slowly fell, thus indicating that a considerable part of the reaction took place within the first few minutes. Typical temperature rise curves are plotted in fig. 3 (A).

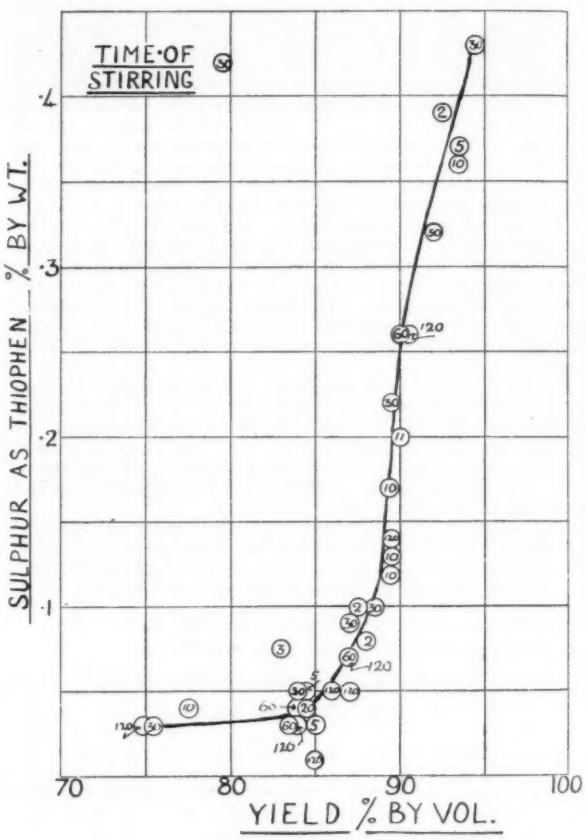


Fig. 2.

The results obtained at temperatures above − 5° C. with a given quantity and strength of acid show that reducing the temperature slightly increases the yield (Table V.). The acid-tar at the lower temperature was slightly more fluid, presumably because less polymerization had taken place, and there appeared to be less tendency to produce sulphur dioxide during the distillation. The amount of thiophen sulphur removed, however, was less at the lower temperatures, and appeared to bear the same relation to the yield as in the tests carried out at room temperatures. Thus, if the thiophen contents are plotted against the yields (fig. 3 (B)), it is found that results obtained at other temperatures lie on this curve, within the limits of experimental error.

These results were checked by a further series of tests on a different benzole over a wider temperature range, the results of which are given in Table VI.

Again, the reduction in thiophen bears practically the same relation to the yield irrespective of temperature.

It was concluded from these tests that no advantage from the point of view of selectivity of thiophen removal is gained by treatment with acid at temperatures either above or below atmospheric temperature within the limits − 30° to 55° C.

TABLE V.—*Effect of Temperature on Acid Treatment of Benzole.*

Strength of Acid (%/Wt.).	Quantity of Acid (%/Vol.).	Washing Loss (%/Vol.).	Yield (%/Vol.).	Sulphur (%/Wt.).			Temperature (° C.).	
				Total.	As CS_2.	As Thiophen.	At Start.	Maximum.
(1) At room temperature—								
98·0	1·0	1·0	92·0	0·61	0·36	0·25	16·7	21·5
98·0	3·0	6·5	86·0	0·46	0·36	0·10	15·3	26·3
98·0	5·0	5·5	85·0	0·46	0·37	0·09	14·5	32·0
82·3	3·0	1·5	92·5	0·69	0·37	0·32	15·4	18·5
82·3	5·0	2·0	90·5	0·60	0·34	0·26	13·5	16·7
77·9	5·0	2·0	93·0	0·79	0·35	0·44	16·6	18·5
77·9	7·0	1·5	93·0	0·75	0·35	0·40	15·9	17·9
(2) At 0° C.—								
98·0	1·0	1·0	92·0	0·68	0·35	0·33	1·5	5·5
98·0	3·0	4·5	88·0	0·46	0·35	0·11	1·5	11·5
98·0	5·0	11·0	81·5	0·41	0·35	0·06	1·1	18·0
82·3	3·0	2·0	92·5	0·80	0·36	0·44	1·3	3·0
82·3	5·0	3·0	92·0	0·73	0·35	0·38	1·7	4·2
(3) At −5° C.—								
98·0	3·0	3·5	89·0	0·48	0·36	0·12	−5·0	3·0
98·0	5·0	5·5	85·0	0·46	0·37	0·09	−5·0	8·6
82·3	5·0	2·5	93·0	0·75	0·35	0·40	−5·0	−4·0
77·9	7·0	2·5	94·0	0·83	0·35	0·48	−5·0	−4·1
Dil. acid only Room temp.	..	0·5	95·0	0·89	0·32	0·57	..	..

(c) *Effect of Added Substances on Acid Treatment.*

There is a further possibility that the action of acid on thiophen and its derivatives can be made more selective by modifying the action of the acid by the addition of certain substances. Kattwinkel,[22] for example, states that boric acid retards the action of sulphuric acid on benzole, owing to the formation of ester-like compounds between the boric acid and phenols, whereas phosphoric acid has the reverse effect. Vanadium oxide has been used to increase the rate of absorption of ethylene and of cracked gases by sulphuric acid in the production of alcohols. The addition to sulphuric acid of various substances, such as nitric acid and aldehydes, has also been suggested for the removal of sulphur compounds, malodorous impurities, &c.

The results of experiments in which various substances have been added to the acid are summarized in Table VII. None of the substances tried had any beneficial effect on the selective removal of thiophen. When a greater reduction of thiophen was obtained, this was only at the expense of yield. In some of these tests the effect of the added substance has been merely to increase the polymerization of the unsaturateds.

(d) *Effect of Treating Separate Fractions.*

Sulphur compounds, other than carbon disulphide, appear to be distributed fairly uniformly throughout the

[22] Kattwinkel. Brennstoff-Chem., 1924, **5**, 5; 1927, **8**, 353.

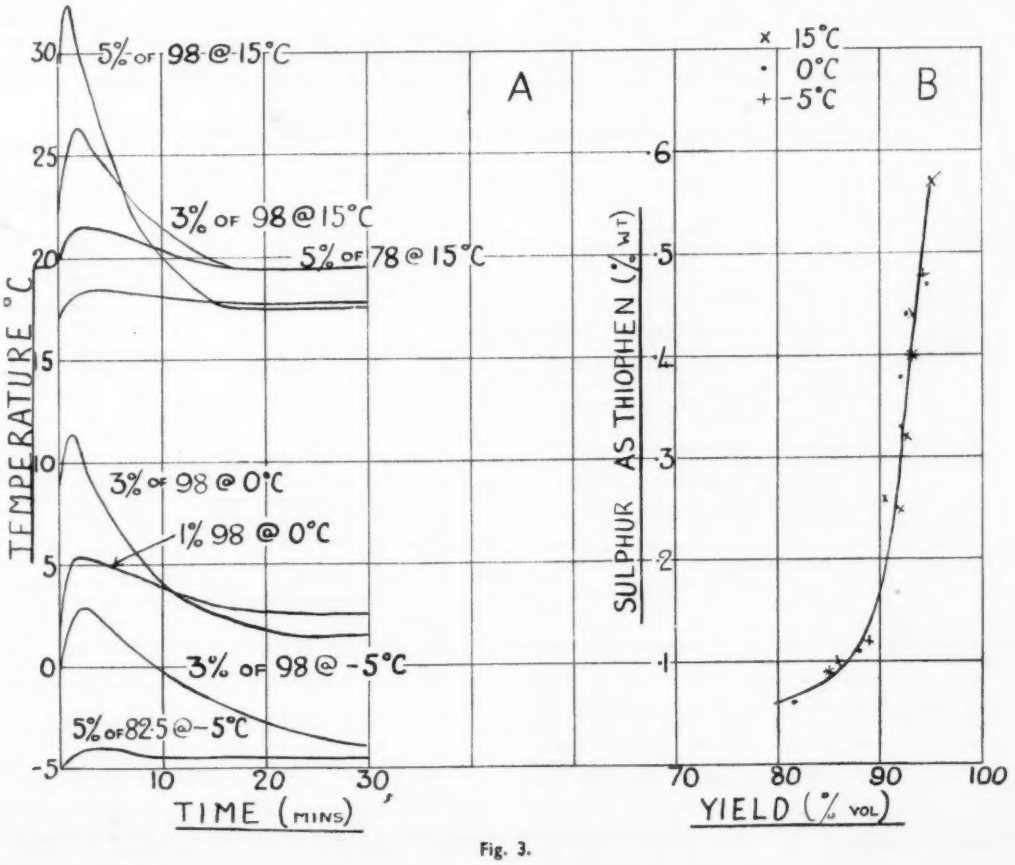


Fig. 3.

TABLE VI.

Acid.	Temp. (° C.).	Yield (%/Vol.).	Total Sulphur (%/Wt.).	Sulphur as CS_2 (%/Wt.).	Sulphur as Thiophen (%/Wt.).	Sulphur as Thiophen Removed (%/Wt.).	Yield* Corresponding with Sulphur Content at Room Temp. (%/Vol.).
No treatment.	..	75·0	0·96	0·44	0·52	..	..
5% of 98% H_2SO_4 . .	−30·0	89·0	0·69	0·46	0·23	0·29	89·25
5% of 98% H_2SO_4 . .	16 5	78·0	0·50	0·45	0·05	0·47	80·0
2% B.O.V. (77%) . .	55·5	89·0	·74	0·46	0 28	0·24	90·0

* From curve with acid in varying strength and amount at atmospheric temperature.

whole distillation range of most benzoles. On the other hand, the unsaturated hydrocarbons are present chiefly in the initial or forerunnings fraction and in the highest-boiling fraction. It is possible, therefore, to obtain a considerable reduction in thiophen sulphur with only a small loss of unsaturated hydrocarbons by separating a benzole into three fractions, removing the thiophen practically completely from the large middle fraction, low in unsaturated hydrocarbons, and finally reblending the fractions. Although this method might be used with advantage when plant is available for separating the benzole continuously into the three fractions, it is too complicated for normal works practice.

It has been proposed instead to divide the benzole into only two fractions, since such a method is more practicable, particularly on works producing solvent naphtha. Tests, therefore, have been carried out in order to determine whether any advantage in the *selective* removal of thiophen can be obtained by treatment of one or both of the two separate fractions with acid, instead of the whole benzole. It appeared possible that the ease of removal with acid of the higher derivatives of thiophen might differ considerably from that of thiophen itself.

The crude benzole used for these tests contained a normal amount of pyridine bases (0·5% by vol.). This benzole was cut into two fractions on distillation over a 12-bulb Young column, (1) up to 100° C. containing practically the whole of the benzene, and (2) from 100° to 180° C. The total volume of the distillate to 180° C. was 91% by volume of the crude, the first fraction being 72% by volume of the distillate to 180° C. and the second 28%. Two hundred millilitres of each fraction were treated with different amounts of acid of varying strength, as previously described. The washed fractions were then mixed in the proportions by volume of 72% of fraction (1) and 28% of fraction (2) and distilled over a 6-bulb Young column to 160° C. The remainder of the high-boiling fraction which had been treated with acid was also distilled to 160° C. in the same way. The total sulphur and the carbon disulphide in these distillates were then determined. The yield of low-boiling fraction was then calculated as follows:

Let d_1 be the percentage volume obtained on distilling the washed, mixed fractions to 160° C.

d_2 be the percentage volume obtained on distilling the washed, high-boiling fraction (2) to 160° C.

Then, the percentage volume obtained by distilling the washed, low-boiling fraction d_3

$$= \frac{100\,d_1 - 28\,d_2}{72}$$

The sulphur as thiophen in the low-boiling fraction was calculated in a similar way.

The total yield and thiophen content of the distillate obtained from the fractions washed separately with acid were then compared with those of the distillate to 160° C., obtained from the whole of the once-run benzole to 180° C. after the same treatment with acid (Table VIII.).

The pyridine contents of the various fractions before treatment with acid were as follows:

(1) Fraction to 100° C. . . . . 0·1% by volume
(2) Fraction 100 to 180° C. . . . . 1·7 ,, ,,
(3) Mixed fractions to 180° C. . . . . 0·5 ,, ,,

It is clear that the most economical method of treatment depends on the proportion of the thiophen sulphur that it is necessary to remove. A reduction in thiophen sulphur from 0·46 to 0·35% by weight may be considered first, since this reduction would bring the total sulphur content of the benzole within the N.B.A. Specification limit of 0·4% by weight, providing the sulphur present as carbon disulphide has been independently reduced to below 0·05% by weight. This reduction in thiophen sulphur can be effected by practically complete removal of the thiophen sulphur from the small, high-boiling fraction, or by partial removal of thiophen sulphur from the benzene fraction to 100° C., or from both fractions, or from the whole benzole. The yields obtained by these different methods of reducing the sulphur are summarized in Table IX. (column 2).

It will be seen that no advantage is gained by attacking only the highest-boiling fraction. The largest yield is obtained by a partial removal of the thiophen sulphur from the fraction to 100° C., as would be expected, since the unsaturateds in the highest-boiling fraction are not involved in the acid-treatment. It is of interest to note that with this benzole, treatment of the separate fractions, each with the same proportion and strength of acid, gave a

TABLE VII.—*Effect of Added Substances on the Removal of Thiophen with Sulphuric Acid.*

Benzole.	Treatment. (½ Hour, Unless Otherwise Stated.)	Yield (%/Vol.).			Sulphur as Thiophen Remaining (%/Wt.).			Remarks.
		No Treatment.	Acid Treatment, no Addition.	Acid Treatment, with Addition.	No Treatment.	Acid Treatment, no Addition.	Acid Treatment, with Addition	
A. Free from phenols or pyridine bases.	7·75% vol. of 73% H_2SO_4 and 0·5% of 36% formaldehyde	95·0	92·0*	88·0	0·52	0·39*	0·39	..
	7·75% vol. of 73% H_2SO_4 and 0·05% of 36% formaldehyde (for 3 hours)	95·0	92·0* 90·0†	88·0	0·52	0·39* 0·27†	0·27	..
	2% of 98% acid containing 1% of H_3BO_4 . .	95·0	88·0†	85·0	0·52	0·15†	0·15	V. thick tar
	2% of 98% acid containing 5% of H_3BO_4 . . .	95·0	87·5†	86·5	0·52	0·14†	0·14	..
	5% of B.O.V. (77%) containing 5% of P_2O_5 . . .	95·0	90·0† 92·0*	90·0	0·52	0·25† 0·30*	0·25	..
	2% of 95% acid containing 2½% of P_2O_5	95·0	87·0† 87·0*	84·5	0·52	0·10† 0·09*	0·10	..
B. Containing traces of phenols and pyridine bases.	3% of B.O.V. (78%) containing 1% of pure HNO_3 .	96·0	94·5*	94·5	0·68	0·53*	0·54	..
C. Containing traces of phenols and pyridine bases.	2% of B.O.V. containing 0·25% of V_2O_5	95·0	93·5*	92·0	0·43	0·34*	0·35	..
	4% of B.O.V. containing 0·25% of V_2O_5	95·0	93·5*	91·5	0·43	0·33*	0·31	..
	4% of B.O.V. containing 1·0% of V_2O_5	95·0	93·5*	91·0	0·43	0·33*	0·26	..

* Direct comparison.
† No direct comparison was made, but the yield for a particular thiophen content was read off from the mean curve with acid alone in varying strength and amount.

TABLE VIII.

Acid Used.		Treatment of Fractions.										Whole Benzole Treated.	
		Fraction to 100° C.				Fraction 100 to 180° C.				Mixed Fractions.			
		Yield.		Sulphur as Thiophen (%/Wt.).		Yield.		Sulphur as Thiophen (%/Wt.).					
Amount (%/Vol.).	Strength (%/Wt.).	As % of Fraction to 100° C.	As % of Total Distillate to 180° C.	In Fraction to 100° C.	In Total Distillate to 160° C.	As % of Fraction 100-180° C.	As % of Total Distillate to 180° C.	In Fraction 100-180° C.	In Total Distillate to 160° C.	Total Yield as % of Total Distillate to 180° C.	Sulphur as Thiophen (%/Wt.).	Total Yield as % of Distillate to 180° C.	Sulphur as Thiophen (%/Wt.).
3·0	20·0	98·5	70·8	0·45	0·333	90·0	25·2	0·48	0·126	96·0	0·46	96·0	0·46
1·0	78·0	96·7	69·6	0·44	0·323	91·0	25·4	0·47	0·126	95·0	0·45	95·5	0·47
3·0	78·0	96·0	69·1	0·36	0·264	89·0	24·9	0·48	0·126	94·0	0·39	93·0	0·40
5·0	78·0	97·2	69·9	0·32	0·237	88·0	24·6	0·48	0·125	94·5	0·36	91·5	0·36
1·0	82·0	97·8	70·4	0·39	0·290	88·0	24·6	0·49	0·127	95·0	0·42	94·0	0·41
3·0	82·0	97·3	70·1	0·33	0·244	87·0	24·4	0·47	0·123	94·5	0·37	91·5	0·32
5·0	82·0	97·0	69·8	0·24	0·180	83·0	23·2	0·28	0·070	93·0	0·25	91·0	0·17
1·0	88·5	96·0	69·1	0·37	0·272	89·0	24·9	0·40	0·106	94·0	0·38	94·0	0·40
3·0	88·5	93·6	67·4	0·26	0·193	84·5	23·6	0·37	0·096	91·0	0·29	91·0	0·20
5·0	88·5	92·5	66·6	0·19	0·142	80·0	22·4	0·08	0·020	89·0	0·16	88·5	0·12
1·0	95·0	94·8	68·2	0·30	0·221	88·5	24·8	0·45	0·120	93·0	0·34	89·5	0·32
3·0	95·0	92·7	66·7	0·19	0·143	78·0	21·8	0·07	0·017	88·5	0·16	87·5	0·08
5·0	95·0	87·5	63·0	0·11	0·082	75·0	21·0	0·08	0·020	84·0	0·10	81·5	0·03

higher yield than treating the whole benzole with acid in the same way. This is probably due to the fact that the high pyridine content of the high-boiling fraction prevents attack of the unsaturateds (and thiophen) in this fraction, when applying only a restricted acid-treatment. In the absence of pyridine bases from a crude benzole, the yield obtained by treating both the fractions with the same proportion and strength of acid for removal of only a portion of the thiophen sulphur has been found to be the same as that obtained by treating the whole benzole in the same way. Most crude benzoles, however, contain pyridine bases and some light treatment of the high-boiling fraction with acid will usually be necessary to remove pyridine bases and render this fraction colourless. It must not be overlooked that in treating this fraction with acid, emulsions are particularly liable to be formed.

When it is necessary to remove a large proportion of thiophen sulphur no advantage is gained by separating the benzole into the two fractions (*cf.* Table IX., columns 3 and 4). This has been confirmed on another benzole free from pyridine bases.

TABLE IX.

Method of Treatment.	Yields (% by Vol.) of Distillate to 180° C. for Reduction in Thiophen Sulphur (% by Wt.).		
	0·46 to 0·35.	0·46 to 0·2.	0·46 to 0·1.
1. Highest-boiling fraction only . . .	92·0	(Impracticable)	(Impracticable)
2. Fraction to 100° C. only	94·0	84·0	(Impracticable)
3. Both fractions separately with acid in same proportion and strength . .	93·5	90·5	84·0
4. Whole benzole . .	92·0	90·5	88·0

Experiments have also been carried out in which a low-boiling fraction was removed, since attention has been focused on this method by the introduction of special columns, such as the Barbet column, which remove carbon disulphide by close fractionation of a forerunnings fraction. The unsaturateds in the forerunnings are very reactive towards sulphuric acid. When not separated by fractionation, however, our preliminary experiments indicated that they are only destroyed by acid to an extent comparable with the thiophen removed. Thus, from the point of view of yield it is more advantageous to remove carbon disulphide by chemical methods than by fractionation.

Summary and Conclusions.

The essential requirements of any refining process for benzole are briefly that:

(1) It should produce a gum-stable benzole.

(2) The refined benzole should be colourless and remain colourless on storage.

(3) The refined benzole should contain less than a specified quantity of sulphur.

(4) These objects should be achieved with the minimum loss of saleable products.

The use of inhibitors enables gum stability to be obtained with practically no loss. Sulphur present as carbon disulphide can be removed with only small losses either by chemical means or by the use of special fractionating columns. Methods also exist for removing odour due to mercaptans, &c., with only small losses, but usually these methods have little or no effect on the total sulphur.

Sulphuric acid still appears to be the simplest and cheapest reagent for removing thiophen sulphur. In the foregoing investigation it has been shown that for any particular benzole the yield obtainable bears a definite relation to the quantity of thiophen removed and is independent of the amount and strength of acid necessary to cause this removal. Moreover, variation in temperature and the addition of catalysts to the acid do not appear to affect this relationship.

Thus for any benzole it is possible by treatment with acid to establish a fundamental sulphur-yield curve which affords a basis for comparing other processes with sulphuric acid treatment. It is clear that any process that removes more thiophen for a given loss than sulphuric acid will produce a sulphur-yield curve lying to the right of the normal curve for sulphuric acid. So far we have found no refining treatment which shows any advantage over sulphuric acid in this respect, and even when gum stability is obtained by the use of inhibitors, the maximum yield obtainable remains dependent essentially on the amount of thiophen that it is necessary to remove.

Colour and pyridine bases, which affect colour stability, are removed by sulphuric acid simultaneously with the thiophen. Excessive quantities of pyridine, however, may interfere with the removal of colour and thiophen owing to the conversion of the acid into pyridine sulphate. With normal benzoles, however, acid of 70 to 80% strength is sufficient to remove the colour. The use of small amounts of concentrated acid (95-98%) is not recommended for removing pyridine bases, owing to the difficulty of removing the acid-tar and the subsequent danger of returning pyridine to the benzole on neutralization.

It has been concluded, therefore, that there is still much to recommend the use of sulphuric acid as a preliminary refining agent on account of its simplicity and general effectiveness. The acid-treatment given can be reduced to the minimum necessary to remove excessive amounts of thiophen sulphur. Little or no regard need be paid to stability, since this can be obtained by the use of inhibitors. The choice of the exact strength and amount of sulphuric acid required is governed to a large extent by factors such as the ease with which the acid can be contacted with the benzole, its subsequent separation, the liability towards sulphur dioxide formation, &c., but for many benzoles of moderate sulphur content, acid of 80 to 85% strength is most suitable. From the point of view of the strength and amount of acid required to cause a certain sulphur reduction in a benzole low in unsaturateds but of high thiophen content, the possible advantages of blending this benzole with one of high unsaturated content should be borne in mind.

THE CONTROL OF Oxide Purification Plant

by J. A. SPEERS, of the Preston Gas Company

A Paper presented at a Meeting of the Manchester and District Junior Gas Association held at Manchester on April 4.

As purification usually represents a small proportion of the total cost of manufacture, and may indeed yield a small profit, the control of the process does not always command the attention it deserves. If, however, the plant conditions are not satisfactory or the material unsuitable the cost may easily amount to an appreciable figure.

When the new works at Preston were put into operation regular tests and observations were made on the purification plant in order to control the process and determine the efficiency and condition of the oxide in each box at any time.

The plant consists of five continuous boxes, four each 60 ft. by 40 ft. and one catch 30 ft. by 40 ft. These are uncovered and exposed along one side, the other side being protected by the earth filling forming the revivifying floor, flush with the top of the boxes. All the boxes were filled with a material which had given satisfaction at the old works, where, however, the purifiers were of very large capacity, and were completely housed. This material worked all right on the light load during the warm summer months, but with the increasing load during the winter months considerable trouble was experienced. This was immediately overcome by the partial substitution of a more active material, and steps were taken to prevent a recurrence of the trouble. These steps fell under the following three headings:

(*a*) Reduction of heat losses from the purifiers.
(*b*) A more complete examination of the oxide to determine its activity and behaviour in use.
(*c*) Closer control of the temperature and moisture content of the material and of the air admitted for revivification *in situ*.

As these were attended with success it may be of interest to detail the action taken.

Reduction of Heat Losses.

Owing to the large area of the plant, complete housing would have been unduly expensive, considering the relatively small amount of time which is normally spent in emptying and filling the boxes.

As the steel covers on each box exposed a large radiating surface it was decided to insulate these on the inside. This was done by nailing 1 in. boards on to wooden joists which were bolted to the angle stiffeners under the lids, the whole being covered with two layers of $\frac{5}{8}$ in. felting on the top side of the boards. Some means of insulating the connecting mains was considered, but this was found to be unnecessary, as the heat losses had been reduced to a reasonably low figure.

The following figures furnish a rough guide as to the success of the scheme:

Average temperature increase through plant before insulating	= 10·8° F.
Average temperature increase through plant after insulating	= 18·3° F.
Difference	= 7·5° F.

Both tests were made under the same conditions and with the same gas flow. The cost of carrying out the scheme was £320, and the expenditure of this amount has been proved justified in the saving of labour and in the improvement of the working of the boxes.

Oxide Used.

In order to have a batch of oxide which will give satisfactory results in a box four points require consideration:

1. Activity.
2. Capacity for hydrogen sulphide absorption.
3. Efficiency.
4. Pressure.

It was considered that if some working standards could be adopted against which batches of oxide could be readily tested it would be a great help in preparing the oxide for use. Chemical analysis alone is not sufficient to determine these characteristics, as so much depends on the physical state of the iron content of the batch. An attempt was therefore made to introduce some laboratory tests, which, although perhaps being of an empirical character, would afford a means of comparison. Many elaborate methods of testing oxide have been described in text books, but these would hardly be suitable for the routine tests carried out in the works laboratory.

At first, attempts were made to reproduce the working conditions in the boxes on a small scale, but these had to be abandoned on account of numerous difficulties and after many experiments we have adopted the following methods to give us a standard.

Activity.

Activity is a measure of the rate of reaction between hydrogen sulphide and iron oxide. This rate varies very considerably with various oxides, and is also governed by such conditions as temperature, moisture, and the presence of retarding agents such as tar.

An oxide which is suitable for working in enclosed boxes at a temperature of 80° F. may prove entirely inactive when the temperature drops to 60° F. Again, an oxide containing, say, 45% of sulphur may be so slow in action that it would be unprofitable to use it again, but if some oxide of very high activity can be mixed with it to bring the activity factor up to the standard, the whole may then be readily worked up to 60% sulphur content in one fouling.

The method we use for obtaining the factor is as follows: 150 grams of the oxide to be tested is weighed out wet, and filled into a calcium chloride tower. A U-tube containing granulated calcium chloride is attached to the outlet, and the whole is weighed. Hydrogen sulphide is generated in a large Kipps' apparatus and passed through a wash bottle containing granulated calcium chloride, and then passed on to the bottom of the tower containing the oxide. At the outlet of the U-tube a potash bulb triangle is filled with clean water so as to give a 2 in. seal before starting to bubble. The air is displaced from the first bottle by a stream of H_2S, and then H_2S is admitted to the oxide tower, the time of first admission being noted. The rate of flow of the H_2S is controlled by a screw clip at the outlet of the Kipps' apparatus, and as soon as the bottom of the column of oxide shows the first traces of fouling, the gas rate is reduced until it is just sufficient to break the 2 in. seal. Four bubbles per minute is sufficient to maintain the pressure, and pass on any residual air.

The oxide blackens at the bottom, and the blackening rises as the fouling proceeds. During the fouling the temperature rises and the rate of absorption increases, so it is often necessary to increase the rate of H_2S to maintain the 2 in. of pressure at the outlet.

Experiments have shown that the initial temperature and the temperature of the H_2S have little effect on the test. The heat of reaction in the oxide is accumulative, raising its temperature, and for any particular oxide an equilibrium temperature is formed by the heat produced and the heat radiated. It is interesting to note that the heat of reaction is nearly all produced at the top point of fouling—*i.e.*, at the top of the blackened portion of the oxide. When the blackened portion reaches the top of the oxide column the H_2S is stopped, the time noted, and the tower and U-tube disconnected and again weighed. The gain of weight indicates the weight of H_2S absorbed, and this weight in grams divided by the time in hours gives us the factor which we have termed the "Reactivity Factor."

Although the conditions of the test are entirely different from those in the boxes, the behaviour of the oxide has been found to bear a close relation to the factor obtained in this way. The following table gives some indication of how this is borne out:

TABLE NO. 1.

Oxide.	Reactivity Factor.	S Content (Wet).	Average Temp. Rise in Box, ° F.	Day's Run before Outlet becomes Foul.	S Absorbed before Outlet becomes Foul (Tons).
New Dutch	1	*Nil*	5	1	0·8
"A" mixture	3	2	1	1½	1·9
"B" "	4	36	14	2	2·2
"C" "	7	29	18	5	3·1
"D" "	14	36	19	4	4·3
"E" "	15	39	22	4	2·6
New artificial	30	*Nil*	20	12	11·4

Capacity.

The knowledge of the capacity of a batch of oxide to absorb hydrogen sulphide is as useful as that of its activity, as by it we can form some idea of the quantity of sulphur it is likely to extract before the box requires emptying. No advantage is to be gained by using a very active oxide which will have a short life and consequently incur high handling costs. Sometimes a very active oxide has a low capacity and *vice versa*. Thus the best results may often be obtained by blending. Capacity naturally varies with the sulphur content.

To obtain the capacity factor, the oxide tower and U-tube which has been weighed for the activity test is immediately replaced in the apparatus and the Kipps turned on to pass H_2S at the rate of 5 or 6 bubbles per minute in the potash bulb. This is left on until there is no further gain in weight in the tower (usually about six hours). It is then weighed again and the total gain in weight over the first weighing in grams is taken as a measure of the capacity.

The results of this test are tabulated below for the same batches of oxide as in Table No. 1:

TABLE No. 2.

Oxide.	Capacity Factor.	Gas Passed as 1st Taker (1,000 Cu.Ft.).	Gain in Sulphur on Dry Basis. %	Sulphur Gain on Original Oxide into Box. Dry Basis.	Remarks.
New Dutch	25	69,369	24·1	27·7	Emptied on account of low activity
"A" mixture	22	243,986	32·6	35·8	
"B" "	9	249,538	10·8	13·6	
"C" "	12	95,544	18·1	29·8	
"D" "	10	283,665	13·2	19·3	
"E" "	11	259,555	15·7	28·6	
New artificial	23	248,802	42·4	58·2	

Efficiency.

It is useful to know the relative efficiencies of batches of oxide, and as the measure of capacity falls with the sulphur content, some measure of the absorption powers of the oxide are required.

Provided the iron content of the oxide when new is known, the content of the batch can be calculated, and from this the efficiency may be derived. This is based on the assumption that all the iron present is in the form of Fe_2O_3. From the equation—$Fe_2O_3 + 3H_2S = Fe_2S_3 + 3H_2O$—1 gram Fe_2O_3 absorbs 0·64 gram H_2S. Then from the capacity factor can be calculated how much H_2S has actually been absorbed by each gram of Fe_2O_3. Thus in the sample of New Dutch, which contained 29% Fe_2O_3, the H_2S absorbed

$$= \frac{25}{150} \times \frac{100}{29} \text{ grams per gram } Fe_2O_3.$$

∴ The percentage efficiency of the Fe_2O_3 present in the oxide was

$$\frac{25}{150} \times \frac{100}{29} \times \frac{100}{0{\cdot}64} = 90\%.$$

TABLE No. 3.

Oxide.	Capacity Factor.	Iron Fe_2O_3. %.	Efficiency. %.
New Dutch.	25	29	50
"A" mixture	22	26	88
"B" "	9	15	63
"C" "	12	22	57
"D" "	10	18	58
"E" "	11	17	68
New artificial	23	26	92

It will be noticed that the New Dutch oxide has a high capacity and efficiency, but the activity is extremely low, and in practice it showed foul on the outlet within one day, and had to be taken out to relieve the next box.

The New Artificial showed a slightly lower capacity but a very high activity and efficiency. This ran for 12 days before showing a stain at the outlet.

We have found that extremely satisfactory results can be obtained by mixing natural and artificial oxides, one of the best all-round mixtures in the list above being "E," which consisted of 65% artificial and 35% natural.

Pressure.

The maximum pressures which may be reached in the purifying plant are of course governed by the depth of seals between the purifiers and exhauster. It is well, however, to keep the initial pressure in a box at a minimum as apart from the greater likelihood of leakage and the additional power required at the exhauster this tends to mount rapidly as sulphur is deposited. Although this increase can be lessened by a careful system of moisture control, we consider with our boxes at Preston an initial pressure of 2 in. should be an absolute maximum. It is, therefore, desirable to have some means of forming an estimate of the probable pressure which will be thrown by a batch of oxide before use. Various methods were tried out to determine the conditions in the box on a laboratory scale but all proved unsuccessful owing to the difficulty of consolidating the oxide to a degree similar to working conditions. The results obtained gave widely divergent results and eventually we adopted a more empirical method.

The initial back pressure depends on many factors, among which are two important items, the size of the particles, and the bulk of the mass. The latter varies with the physical characteristics of the oxide particles, shape, roughness, moisture, &c.

After experimenting on pressures thrown by oxide which had passed various sieves when dry, it appeared that almost all the back pressure was caused by the particles which would pass a 1/40 in. mesh sieve. The bulk can be approximately ascertained by filling the interstices with benzene and noting the amount required. We have therefore adopted the following tests as a standard.

About 200 grams of oxide are dried in an oven, and when cool 100 grams are weighed out and screened on a 1/40 in. mesh sieve. The amount that has passed is weighed and expressed as a percentage. A wide-necked bottle is then weighed, filled with benzene, weighed again, and the weight of benzene calculated. The benzene is then poured out and the bottle filled with the moist oxide and weighed. Benzene is poured on till full and the bottle is tapped to displace any air bubbles. The whole is then weighed and the difference between the last two weighings gives the weight of benzene required to fill the interstices. This weight divided by the weight of the first benzene gives the proportion of free space in the oxide.

The pressure is then calculated from the empirical formula, which has been evolved from experimental data:

$$P = \frac{(ab)^2}{300}$$

where P = back pressure thrown by box in inches of water.
a = percentage of oxide passing the 1/40 in. mesh sieve.
b = bulk.

This formula is approximately true in the case of our boxes for a make of 100,000 cu.ft. per hour.

This, of course, varies with the gas make, which can be allowed for by arranging the orifice formula

$$P_2 - P_1 = K \left(\frac{A_1}{A_2}\right)^2 (V_2^2 - V_1^2) \text{ to apply to the case.}$$

If $P_2 - P_1$ = Alteration in pressure due to the make, and assuming
$A_2 = A_1$ (1 − bulk),
V_1 = standard gas rate in thousands of cubic feet per hour (in our case 100),
V_2 = actual gas rate in thousands of cubic feet per hour,
K = a constant $\left(\text{experimentally fixed at } \frac{1}{100{,}000}\right)$,

the formula then becomes—

$$P_2 - P_1 = \frac{V_2^2 - V_1^2}{(1 - \text{bulk})^2 \times 100{,}000}$$

The result is added to or subtracted from the calculated pressure for the standard make. The following table gives an indication of how the calculated results compared with those obtained in practice.

TABLE No. 4.

Oxide	% Under 40 Mesh. (a)	Bulk. (b)	$\frac{(ab)^2}{300}$	Hourly Make (1,000 Cu.Ft.).	Calculated Pressure.	Actual Initial Pressure.
New Dutch	31	0·60	1·1	65	0·7	0·6
"B" mixture	16	0·57	0·3	1·3	0·3	0·3
"C" "	42	0·61	2·2	112	2·4	2·4
"E" "	36	0·52	1·1	93	1·1	1·1
New artificial	41	0·30	0·5	119	0·6	0·4

Having reviewed the various methods we have adopted for testing the oxide, it is useful to consider how they can be applied in preparing a batch of oxide for use.

Moisture.

Moisture has a bearing on pressure and activity and it is desirable to find the most suitable moisture content for both purposes.

A series of tests was made on the pressure thrown by a column of oxide in a tower at constant gas rate when the moisture content was varied. This was carried out with various batches, and it was found that the pressure decreased as the moisture increased up to a certain limit. Beyond this limit the pressure again increased, showing

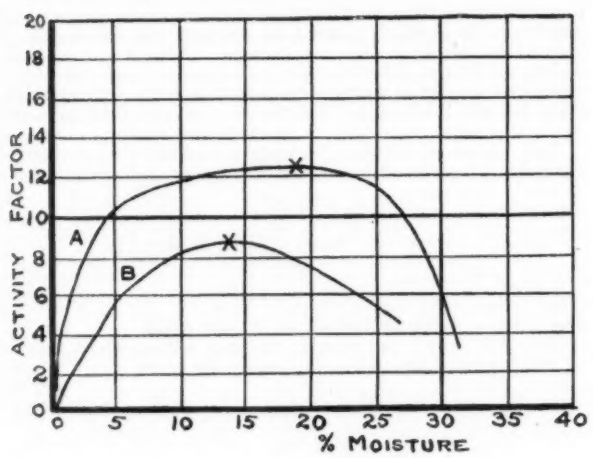
that there is a saturation point beyond which it is undesirable to go.

When examined through a microscope it was found that the water at this point completely filled all the pittings of the oxide particles, and when the moisture was further increased it began to join up, filling the interstices. At this saturation point the particles will just hold together when squeezed, and fall away again when the pressure is taken off. This point was tested for a number of samples with the following results:

TABLE No. 5.

Oxide.	Sulphur and Tar (Dry Basis).	Sulphur and Tar (Wet Basis).	Saturation Moisture.	Moisture on S-Free Base.
	%	%	%	%
New Dutch . . .	..	..	42	42
"B" mixture . . .	47	36	24	37
"B" (after fouling) .	58	49	17	32
"C" mixture . . .	38	28	27	37
"F" " . . .	30	22	28	35
New artificial . . .	..	..	36	36
Artificial once fouled.	42	34	20	30

It will be noted that the moisture content of the oxide when saturated expressed on the sulphur and tar-free basis remains roughly between 30 and 40% in each case. Tests were then made to find the relation between moisture and activity, and the following graph shows the variations:



Graph No. 1.

X indicates saturation point. A is 100% artificial oxide, 35% sulphur. B is 100% natural oxide with 12% sulphur.

Artificial oxides have a greater activity range than natural, but it will be seen that the saturation point falls on the high part of the activity curve in each case. This shows that this point should not be exceeded, as it is important to remember that every drop of excess moisture is absorbing more heat from the chemical action when the box is warming up and tends to make it more sluggish in starting. An excess of 5% on a box containing 100 tons of oxide would require an extra 168,000 B.Th.U. to bring about a temperature rise of 15° F.

It is known that 1,000 cu.ft. containing 500 grains of H_2S per 100 cu.ft. generate 196 B.Th.U., thus it requires to purify 858,000 cu.ft. of gas above normal to bring this inert moisture to working temperature. The lowest moisture consistent with good working should therefore be aimed at. This gives support to the time-honoured practice of estimating the correct moisture content by picking up a handful and squeezing it, the correct amount being that which will just bind the particles without any liquid running out. Care must, of course, be taken to test a sample representative of the batch.

Mixtures.

It sometimes occurs that a batch of oxide has a fairly high sulphur content, but its activity has fallen so low that it is undesirable to use it again. The same may apply to oxide inactive for other reasons—*e.g.*, certain bog ores.

By the judicious addition of some highly active material a mixture can be obtained which can be readily worked up to a salable sulphur content. The activity of the batch should be considered along with other factors, but generally we have found it undesirable to re-use it alone with an activity factor lower than 10. When preparing a batch of oxide it is necessary to bear in mind the pressure likely to be thrown, and for this reason it is undesirable to pass the oxide through the disintegrator more than once. Intimacy of mixing is essential, otherwise the activity of a box tends to become that of the lowest part of the oxide. Mixing through the disintegrator is the most convenient way of doing this.

If, however, part or all of the oxide has already been broken, this method is unsuitable, and at Preston we have found the most convenient method is to spread the oxide out on the revivifying floor to a depth of about 1 ft., spreading the constituent parts in layers, and turning over the whole with a plough three or four times. This gives a fairly intimate mixture without powdering it any finer.

Apart from the inconvenience of a sudden rise in back pressure increasing the total pressure on the washing plant and exhausters, there is always a danger of the swelling oxide cracking the purifier plates. At Preston two balcony plates were cracked through this cause, and as a precautionary measure when refilling we put a 3 ft. row of steel plates on the grids of the top layer along the valve side of the box. When the box came to be emptied the oxide under and above these plates was found to be quite soft, acting as a buffer to the caking oxide, thus taking the pressure off the box sides. The success of this led us to adopt it regularly, and since this time we have had no further sign of cracking of the plates.

CONTROL OF BOXES.

Routine Tests.

To enable a knowledge to be obtained of the exact state of each box routine tests are carried out daily and tabulated on record sheets. These consist of:

Temperature at inlet and outlet of each box.
Quantity of H_2S at inlet to purifiers.
Quantity of H_2S at outlet of each box.
Oxygen in gas entering purifiers.
Oxygen in gas leaving purifiers.
Pressure thrown by each box.

Application.

Some consideration of the reactions taking place inside the boxes have helped in the application of the above results. With a view to investigating, special tests were made on two batches when the boxes were opened for emptying. A pillar of oxide 1 ft. square was taken from each layer of the two boxes from points near the middle of the box where the oxide had caked hard enough to be lifted out in a single piece. Tests were made on the constituents in samples taken every 2 in. from top to bottom of each pillar.

The first case was that of a box which had been filled with new artificial oxide, and which had passed 249 million cu.ft. of gas, the second being a mixture of old oxides which had been worked up to a salable sulphur content.

The results obtained with the new oxide are tabulated below:

TABLE No 6

	Average Depth of Layer (Ins.).	Moisture.	Sulphur (Dry Basis).	Sulphur (Dry Inert-Free Basis).	Tar (Dry Basis).	Ammonia Salts (as $(NH_4)_2SO_4$).
Top Layer	1	20·9	53·3	47·4	3·6	7·6
	3	18·3	51·4	49·0	2·8	7·1
	5	16·3	52·2	48·2	2·6	5·0
	7	15·5	53·8	51·0	0·7	4·5
	9	14·5	55·4	52·0	1·0	5·0
	11	15·0	58·0	55·0	1·0	4·2
	13	13·3	57·6	54·9	1·0	3·7
	15	12·0	51·3	49·1	1·0	3·4
	17	10·3	51·2	49·0	1·0	3·0
	19	8·6	50·7	48·9	0·8	2·5
	21	8·7	50·0	48·6	0·7	2·0
	23	8·1	47·8	46·4	0·7	2·1
	25	13·4	42·2	40·7	0·4	3·1
Bottom Layer	1	8·4	47·7	46·6	0·7	1·4
	3	7·2	47·0	45·1	2·5	1·5
	5	6·4	46·5	44·8	2·0	1·6
	7	5·2	45·8	44·7	1·2	1·3
	9	6·2	45·2	43·4	1·4	1·5
	11	5·9	44·3	43·0	1·0	1·8
	13	5·8	43·8	41·7	1·0	1·7
	15	6·7	41·0	39·8	1·0	1·9
	17	7·4	36·7	35·9	0·6	1·8
	19	9·4	31·7	31·0	0·2	2·0
	21	8·7	28·6	27·9	0·1	2·0

In each case there was a fall in the sulphur content, calculated on the inert-free basis, from the top of the layer, and a marked increase near the centre, followed by a regular fall to the bottom. The fall can be attributed to action becoming less owing to the smaller partial pressure of the hydrogen sulphide in the gas. The rise towards the centre with a corresponding drop in moisture at a

point just below it points to a local high temperature being formed which would lead to a region of high activity. It may be deduced from this that gas temperature at the outlet of a box does not serve as any actual measure of temperature attained inside that box but, nevertheless, the difference between the inlet and outlet temperatures serves as a useful guide to the activity of the material.

For convenience in reading we have placed cased thermometers at the inlet and outlet of each box which gives the required temperature indication. We have found that the recorded difference between the readings compares sufficiently closely with those taken on exposed thermometers to warrant the former being retained for record purposes.

Rotation.

When a box becomes first "taker" it is allowed to remain as such as long as it is sufficiently active. This has the advantage of conserving as much of the reaction heat as possible, as a considerable amount of energy is required to bring the material up to a working temperature, and this is lost when a change-over takes place.

The boxes are worked in backward rotation, and in determining when to make a change, a box is usually kept on until it passes 25% of the hydrogen sulphide admitted, or until the outlet of the second "taker" becomes foul. Revivification *in situ* is a much slower reaction than sulphiding, but the heat evolved is nearly ten times as much, 2,390 B.Th.U. being liberated in revivification per 1,000 cu.ft. of gas containing 1% hydrogen sulphide, as against 245 B.Th.U. in sulphiding. When the boxes are given approximately the same period of run, each box has three times the period in revivifying positions that it has in sulphiding.

Air Admission.

The quantity of air admitted is governed by the percentage of oxygen in the gas at the outlet of the purifiers and usually amounts to about 2½% of the make. From experiments we have found that the first "taker" will absorb a large proportion of the oxygen admitted when it is sulphiding, and this helps to prolong its useful life. A typical oxygen absorption test is:

Taker . .	1.		2.		3.		4.	
	In.	Out.	In.	Out.	In.	Out.	In.	Out.
O_2% . . .	1·1	0·7	0·7	0·5	0·5	0·4	0·4	0·4
O_2% absorbed	0·4		0·2		0·1		0	

The figure of 0·4 seems to be a minimum below which it is impossible to react on account of the low partial pressure exerted.

More complete revivification can often be obtained if more air is admitted, but this has the disadvantage of increasing the inerts and reducing the calorific value. If the calorific value is being easily maintained and it is doubtful if the last "taker" is completely revivified, the air admitted is increased to about 4% for a few hours, in this case a typical absorption test is:

Taker . .	1.		2.		3.		4.	
	In.	Out.	In.	Out	In.	Out.	In.	Out.
O_2% . . .	1·4	1·0	1·0	0·7	0·7	0·5	0·5	0·4
O_2% absorbed	0·4		0·3		0·2		0·1	

If the oxygen at the outlet is above 0·6% the last box is considered to have revivified as far as the reaction will go *in situ*.

If the local temperature rises sufficiently, direct combination between the hydrogen sulphide and oxygen can occur, the particles of oxide acting as a catalyst, and, if carried still higher, the "Claus Kiln" effect can be observed, at which stage sulphur dioxide is carried forward in the outlet gases, and ferrous sulphate formed in the box. This may account for the relatively large amount of oxygen which is absorbed by the first "taker" when the box has fully warmed up.

If excessive steaming is carried out, or the local temperature rises above 212° F., an equilibrium is established:

$$SO_2 + 2H_2S \rightleftharpoons 3S + 2H_2O.$$

Both ferric and ferrous sulphides are completely hydrolized at this temperature by the steam, evolving hydrogen sulphide, which causes foul gas to issue from the box. This possibly accounts for foul gas sometimes being detected at the outlet of a box which is revivifying when the gas entering it is clean. We have occasionally had this experience at Preston when a large amount of live steam has been admitted.

Steaming.

From trials we have found that indirect heating of the gas by steam coils does not prove satisfactory in the case of exposed purifiers. The specific heat of gas is low compared with that of the purifying material, and the increase in temperature is rapidly lost through the side plates and balconies.

We have therefore adopted a system of controlled admission of live steam at the inlet of the first "taker" so that the gas at the outlet has a temperature of 80° F. In warm weather, and when a box has been first "taker" for two or three days, the gas will usually have this temperature without steam admission. Excessive steaming is to be avoided, as when the last "taker" is revivified and cools, it acts as a condenser, and soon becomes sodden, quickly losing its activity.

The inlet temperature of the gas is never allowed to exceed 70° F., and under these conditions we find that the oxide retains its moisture without becoming sodden. It should be pointed out, however, that this system of steaming has only been practicable since the insulation of the lids.

A catch box will normally be at a low temperature, and consequently should be filled with a highly active oxide, the capacity being of little or no consequence.

At Preston we keep the catch box by-passed under gas pressure, only using it when required. This helps to keep the oxide from becoming sodden, otherwise the activity would be too low to remove the traces of H_2S which it is required to do.

A consideration of the reduction in working costs will help to show how the system of control is succeeding.

In the following table the calculated profit on oxide is the difference between the amount received for the spent oxide taken over a considerable period and the original cost of the new oxide, as the purchase of new material and the sale of spent does not necessarily fall within the same financial year.

Date.	Cost per 1,000 Cu.Ft.					Net Cost per Therm.
	Labour.	Depreciation on Grids, &c., and Sundries.	Total.	*Less* Calculated Profit on Oxide.	Net Purifying Cost.	
	d.	d.	d.	d.	d.	d.
1932. .	0·211	0·026	0·237	0·090	0·147	0·031
1933. .	0·098	0·026	0·124	0·077	0·047	0·010
1934. .	0·074	0·026	0·100	0·074	0·026	0·005
1935. .	0·055	0·026	0·081	0·074	0·007	0·001

As during this period we have been using up partially spent material from our old works the actual profit realized on oxide has exceeded the above calculated figure.

Finally I should like to acknowledge my indebtedness to my Chief, Mr. Samuel Tagg, J.P., M.Inst.C.E., for permission to publish the figures in this Paper and for the help and encouragement he has afforded me.

Discussion.

The PRESIDENT (Mr. A. K. Collinge) said that the work had been carried out with the object of forecasting what happened in the purifying boxes. It had been put in hand because Preston had 1,500 tons of oxide for disposal in varying stages of sulphur content and of poor activity. The process evolved had enabled that quantity of oxide to be worked up economically.

Mr. S. CARTER (Liverpool) said that he was particularly interested in the insulation of the covers of the boxes. He had thought for a long time that someone should invent a paint that could be used for insulation purposes. It should not have to be necessary to use coils to heat up to the gas. Some time ago they had a peculiar experience at Liverpool. The gas was changed from down-stream to up-stream with beneficial results. A change was afterwards made from up-stream to down-stream, but it had to be changed back again quickly. He found that a 2-2-1 oxide mixture was best for catch boxes—*i.e.*, two parts of old oxide, two parts of new oxide, and one part of "Lux." This mixture had also been found good for water gas. To by-pass catch boxes during the summer time was very wise, but it was no use in the winter.

Mr. H. PLATT (Bolton) pointed out that it was essential that laboratory work should be adapted to works' practice where variable conditions existed. It would be advantageous if more information could be given in regard to the depth of oxide in the boxes, make of gas passed through, &c.

Mr. J. ALBINSON (Manchester) stated that Mr. Speers confirmed the optimum moisture content as 14/18%. There was still a good deal of fundamental work required in connection with purification.

In reply to Mr. Carter, the AUTHOR stated that recently they had put into the catch boxes a mixture similar to that in use at Liverpool—viz., ⅔ partly spent oxide and ⅓ "Lux" and new oxide, and in very cold weather it was advisable to warm it up. If left alone it became a condenser, and it was essential to maintain dryness in a catch box. At Preston the practice was to use it one day a fortnight and then shut it off.

Mr. ALBINSON (Manchester) proposed a vote of thanks to Mr. Speers, which was seconded by Mr. PLATT (Bolton).

The Rectifier Photo-Electric Cell Applied to Control Gas Lighting

by
W. H. B. HALL

From a Paper presented at a meeting of the Illuminating Engineering Society held at the Institution of Mechanical Engineers, Storey's Gate, S.W. 1, on Tuesday, April 7.

The South Metropolitan Gas Company was recently engaged in re-designing the gas lighting of a London school classroom. While the work was in progress, a desire was expressed by the school authorities for an automatic device to light and extinguish the lamps when daylight illumination either falls below or exceeds a predetermined standard. To supply this demand the Company has produced at a moderate cost an automatic controller (provisionally protected) which satisfactorily fulfils the prescribed conditions.

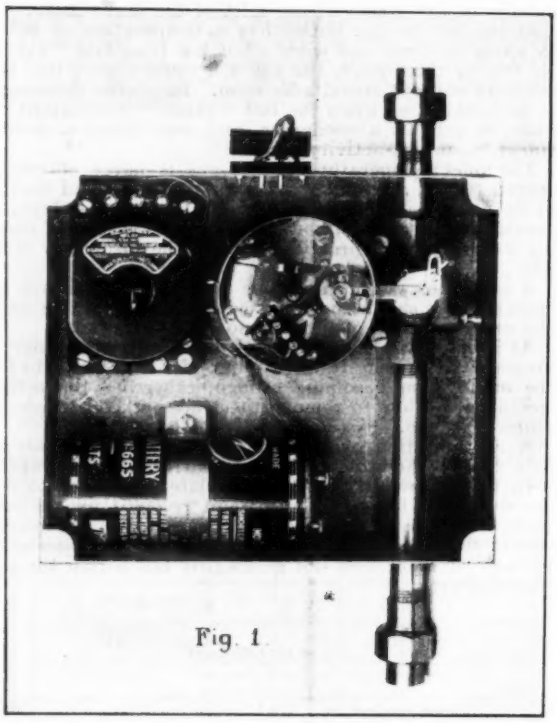


Fig. 1

The controller is shown assembled in fig. 1. It is built up from components which are in common use, comprising a rectifier photo-electric cell, a sensitive galvanometer relay fitted with a maximum and a minimum contact, a 3-volt dry cell, and a time-actuated street lamp controller of the same type as that already familiar to the Gas Industry. The complete unit, with the exception of the photo-electric cell, is included in an iron box 11 in. by 11 in. by 4 in., and, in use, is fitted in parallel with the main control tap of the lighting installation. The photo-electric cell can be placed in any suitable position in the room, and is connected to the rest of the apparatus by means of copper leads. The only component that has been modified is the street lamp controller. This has been altered by the removal of the time-actuating mechanism and its replacement by an electro-magnetic device for starting the spring motor, which turns the gas cock.

By the use of one relay in combination with a system of contacts to be described later, it is possible to supply all the energy for operating the electro-magnetic actuating device from a small 3-volt dry cell, which gives many months of service. The attention required from the teacher is, therefore, reduced to winding the spring of the motor, the frequency of which operation depends upon the number of times the gas cock is operated. The spring used actually requires rewinding after 150 operations of the gas cock.

The components of the device and the electrical connections are shown diagrammatically in fig. 2. The photo-electric cell (1) is of the rectifier type. When light falls on its sensitized surface an electric current is generated, the magnitude of which depends primarily on the intensity of the light. The relay (2) (fig. 2) is essentially a moving-coil galvanometer arranged in such a manner that when the moving coil is deflected it carries with it a conductor A, which makes contact with B when the current flowing in the coil is a minimum, and with C when the current is a maximum. The component (3) (fig. 2) is a small electro-magnet which, when energized, attracts a simple iron armature, to which is attached the starting lever of the spring motor. E and D represent two contacts, which are "made" and "broken" by the gas cock as it turns from the "off" to the "on" position. When the conductors of E are touching those of D are separated. These contacts are arranged so that when the relay conductors A and B are in contact D is separated. When A touches C the conductors at E are separated. The current from the battery, therefore, flows in one of the alternative paths, A, B, D, F or A, C, E, F.

The arrangement of the electro-magnet is illustrated in fig. 3. When the magnet H is energized it attracts the armature I and operates the starting lever J of the spring motor.

Attached to the shaft of the pinion turning the cock is a disc K which carries two lugs L and L'. The two contacts E and D shown in fig. 2 are represented in fig. 3 by the contacts E, D, and O. O represents the common member which is joined directly to the electro-magnet (see fig. 2). The second conductors of D and E (fig. 2) are shown in fig. 3 mounted respectively above and below the common member O. The contacts are mounted in such a manner that when O is depressed, contact E is made, and when raised, contact D is made. The lugs L and L' are bevelled in such a way that when the disc K rotates with the gas cock, the common member O is depressed by L' into contact with E and raised by L into contact with D. The disc K is coupled to the gas cock so that the common member O is raised into contact with D when the gas cock

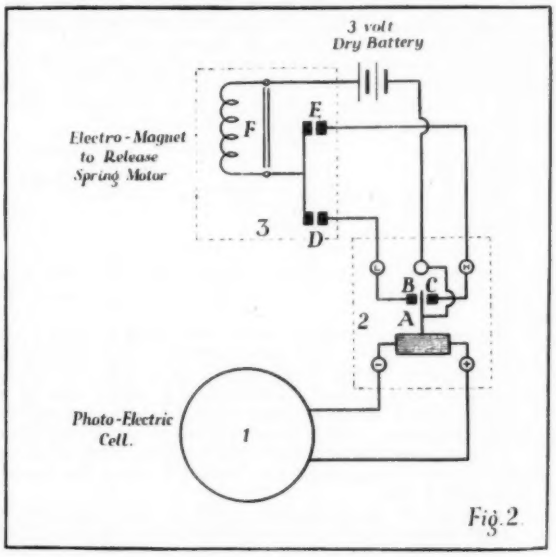


Fig. 2

is "off," and is depressed into contact with E when the gas cock is "on." The object of this arrangement of contacts is to permit an electric impulse to pass through the coil of the magnet, thus setting the spring motor into motion, and then to interrupt the flow of current. Current is thereby economized, and it becomes possible to operate the device by a small dry cell. The function of the switches is made clear by considering the sequence of operations of the complete apparatus.

Assume the natural light falling on the photo-electric cell is at the standard intensity. Then the current generated by the cell will deflect the conductor A (fig. 2) of the relay into the neutral position; the gas lamps are "out" and

* Provisionally protected.

contact D (fig. 2) is "made." Now as the light diminishes to the lower limit, A approaches B, and eventually they touch, consequently a current flows along the path A, B, D, F. The electro-magnet is energized, and the spring motor is started. The control cock is thus turned to the "on" position, and simultaneously contact D is "broken" and E is "made," hence the battery circuit is broken, and

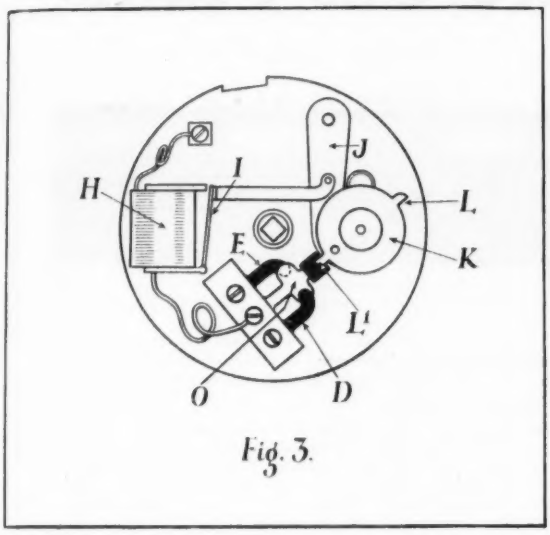


Fig. 3.

current ceases to flow from the dry cell. The position now is: the gas burners are alight, contact D is broken, A and B are touching, and contact E is "made" ready for the next operation to extinguish the burners. As daylight improves the moving conductor A leaves contact B, and when the upper limit of daylight is reached A and C come into contact. A current now flows in the circuits A, C, E, F, operates the magnet, turns the gas cock into the "off" position, and contact E is "broken" at the same time contact D is made in readiness for the next operation.

Discussion.

The PRESIDENT (Mr. A. W. Beuttell) thought that Mr. Hall's Paper was definite evidence that the Gas Industry was losing some of its shyness to use electricity.

Dr. J. W. T. WALSH expressed admiration for the ingenuity employed in the device.

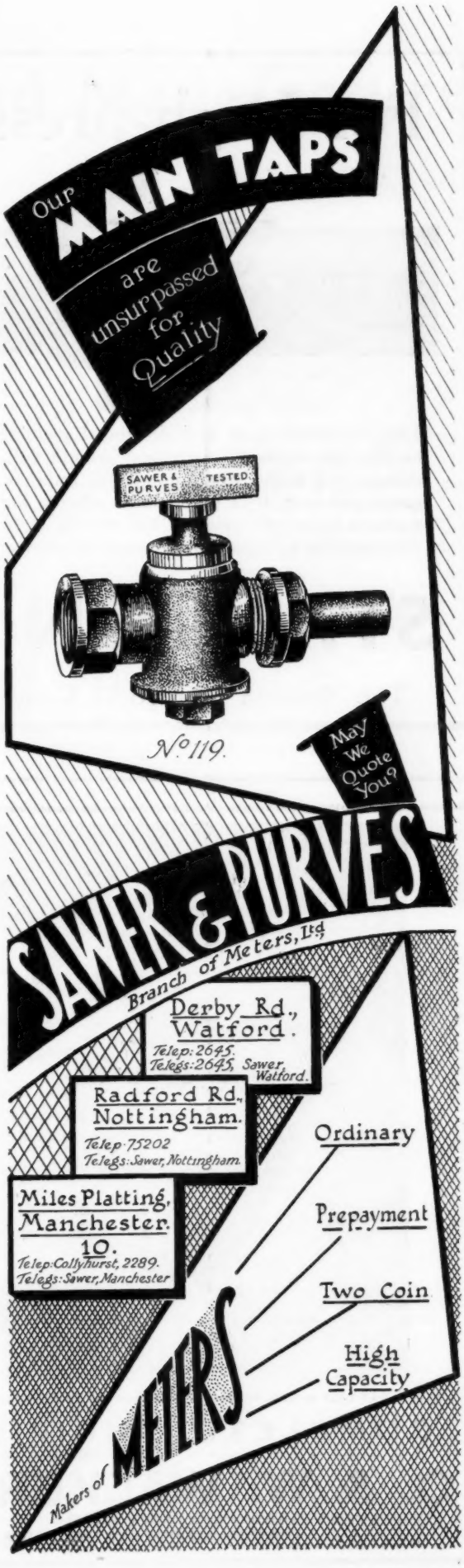
Lieut.-Col. K. EDGECUMBE congratulated Mr. Hall upon his courage in having successfully tackled the problem of operating a gas tap with so small a relay. He asked Mr. Hall what were the limits that the relay operated at in terms of foot-candles, and also if he could give him any idea of where the sensitive element was fixed.

Mr. GILBERT pointed out that years ago his firm had used a similar relay to that described by Mr. Hall for switching on and off an electric lighting installation. In their case they had, however, made use of a high-tension battery of sixty to seventy volts as against the small potential of three volts employed by the Author.

Mr. F. C. SMITH (Gas Light and Coke Company), in reply to the President's remark that the Gas Industry was losing some of its shyness for the employment of electricity in their devices, said that they had always been willing to use electricity when it was the best thing for their work. In the same way he suggested the electricity people were not backward in using gas when they thought that it was the best thing for their work. So really there was no question of shyness. He went on to stress the great need for the careful handling of all light sensitive cells. This he suggested would go a long way to reducing any errors that might occur in their operation. The "Radiovisor," he observed, had been used for the operation of gas street lamps. For this, however, they had to rely on dry cells, and they did not like using dry cells in places where they were subjected to violent changes of temperature or light. While congratulating Mr. Hall upon the application of the photo-electric cell to gas lighting, he wondered, nevertheless, to what extent the nicety of design of the tap played a part in its successful operation.

The Author's Reply.

In reply to Col. Edgecumbe, Mr. W. H. B. HALL said that the instrument was set so that the light was turned on if the daylight in the room fell to 5 ft.-candles which, with the artificial illumination of 7 ft.-candles, gave a total light intensity of 12 ft.-candles in all. The relay contacts were set so that when the daylight rose to 7 ft.-candles the lamp was extinguished. The only means of securing the best position for the sensitive element was by trial and error. The range of the instrument could be varied by altering the spacing of the contacts in the galvanometer relay. When tested with a Weston photometer on a cloudy day it was found that the instrument varied only to the extent of about ½ ft.-candle.



For High-pressure Gas Mains

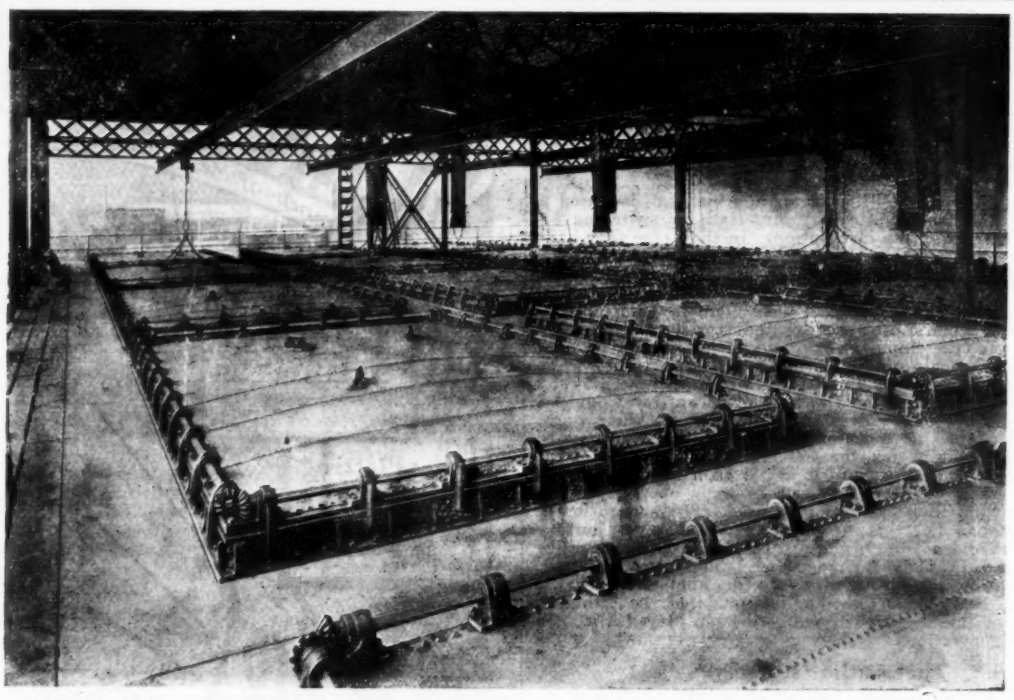
THE Stanton-Wilson Self-adjusting Pipe-joint enables gas mains to withstand ground subsidence and traffic vibration. Being leaktight under pressure, it is particularly suitable for mains in gas supply systems. Well over 300,000 Stanton-Wilson Joints are now actually in service.

Stanton-Wilson Joints are available with Stanton "New" Spun Iron Pipes in diameters ranging from 3 inches to 15 inches.

These pipes are centrifugally cast without chill by a patented process which increases their impact resistance to beyond anything obtainable with the thicker sand-cast pipe. Gas cannot percolate through the dense, non-porous structure of the "New" spun metal.

STANTON "NEW" SPUN IRON PIPE -WILSON SELF-ADJUSTING JOINT

The Stanton Ironworks Company Limited, Near Nottingham



PART OF A SET OF EIGHT PURIFIERS, 46 FT. x 32½ FT., ERECTED ON STAGE FLOOR AT LIVERPOOL.

COMPLETE PURIFIER INSTALLATIONS
WITH BOXES IN C.I. OR STEEL

C. & W. WALKER, LTD., DONNINGTON, Near WELLINGTON—SHROPSHIRE.

'Phone: Lilleshall-Shropshire Nos. 34 & 35 (2 lines) 'Grams: "Fortress," Donnington, Shropshire
LONDON OFFICE: 70, VICTORIA STREET, WESTMINSTER, S.W.1.
'Phone: Victoria No. 1941 'Grams: "Fortress," Sowest, London

Gas Markets and Manufactures

Stock Market Report

(For Stock and Share Lists, see later pages)

Up to Wednesday of last week the volume of business passing on the Stock Exchange was heavier than anticipated, though subsequently holiday considerations were responsible for a general slackening off in most sections. Home rails, on the hopes of good Easter traffics, were again active particularly the preference group, and there was also an increased demand for the ordinary stocks. Comparatively little interest was taken in gilt-edged securities and prices finished a shade lower. Industrials for the most part remained steady, a feature at the close being the heavy demand for Pressed Steel new 5s. shares.

Business in the Gas Market was also on a reduced scale, though prices continued firm and for the most part unchanged. Dealings in the Gas Light new debenture issue commenced on Wednesday and quickly went to 1½ premium, while business was done the following day at 2 premium. On the London Exchange Gas Light units hardened 3d. to 28s., at which price the yield works out at 4%, and having regard to the high-class security offered continues its popularity as a permanent investment. South Metropolitan went ahead again, closing a point up at 128½, and South Suburban also hardened 1 to 133½. The margin of Imperial Continental narrowed to 5 points resulting in a net gain of 3½ to 178½. A feature in the Supplementary List was the strength of Bognor ordinary stocks, the original rising 13 points to 180 and the new stock 11½ points to 178½.

Current Sales of Gas Products

The London Market for Tar Products.

April 9.

The prices of tar products remain as quoted on the 6th instant.
Pitch is nominal at about 40s. per ton f.o.b.
Creosote, 5¼d. per gallon.
Refined tar, 3¾d. per gallon in bulk at makers' works.
Pure toluole, about 2s. 8d.; pure benzole, 1s. 7d. to 1s. 8d.; 95/160 solvent naphtha, about 1s. 8d.; and 90/160 pyridine, about 4s. 3d. to 4s. 6d.—all per gallon naked at makers' works.

Tar Products in the Provinces.

April 9.

The average prices of gas-works products during the week were: Gas-works tar, 24s. 3d. to 29s. 3d. Pitch—East Coast, 42s. 6d. to 45s. f.o.b. West Coast—Manchester, Liverpool, Clyde, 42s. 6d. to 45s.* Toluole, naked, North, 2s. 2d. to 2s. 4d. Coal-tar crude naphtha, in bulk, North, 8d. to 8½d. Solvent naphtha, naked, North, 1s. 6d. to 1s. 6½d. Heavy naphtha, North, 1s. to 1s. 1d. Creosote, *ex* works, in bulk, North, liquid and salty, 4⅝d. to 4⅞d.; low gravity, 4⅝d. to 4⅝d. Heavy oils, in bulk, North, 4¾d. to 5d. Carbolic acid 60's, 2s. 4d. to 2s. 6d. Naphthalene, £19 to £21. Salts, 95s. to 100s., bags included. Anthracene "A" quality, 2½d. to 3d. per minimum 40%, purely nominal; "B" quality, unsalable.

* All prices for pitch are now quoted on the basis of f.o.b. In order to arrive at the f.a.s. value at any port it will be necessary to deduct the loading costs and the tolls whatever they may be.

Tar Products in Scotland.

GLASGOW, *April* 11.

Owing to the lack of prompt supplies business is now somewhat restricted in this area.

Crude gas-works tar.—The actual value is now 34s. to 35s. per ton *ex* works in bulk.

Pitch remains uninteresting at 35s. to 37s. 6d. per ton f.o.b. Glasgow for export, and 35s. per ton *ex* works in bulk for home trade.

Refined tar is higher for home consumption at 3d. to 3¼d. per gallon f.o.r. works in buyers' packages.

Creosote oil.—Demand continues steady but quotations are unchanged as under. B.E.S.A. Specification, 5¼d. to 5⅝d. per gallon; low gravity, 5¼d. to 5½d. per gallon; neutral oil, 5¼d. to 5½d. per gallon; all *ex* works in bulk.

Cresylic acid.—Supplies are limited and values are not lower than the following: Pale, 97/99%, 1s. 9d. to 1s. 10d. per gallon; dark, 97/99%, 1s. 7d. to 1s. 8d. per gallon; pale, 99/100%, 2s. to 2s. 3d. per gallon; all *ex* works naked.

Crude naphtha is only available in small quantities with value steady at 5¼d. to 5⅜d. per gallon according to quality and district.

Solvent naphtha.—90/160 grade is now 1s. 5d. to 1s. 6d. per gallon and 90/190 heavy naphtha is unchanged at 1s. to 1s. 1d. per gallon.

Motor benzole continues to command 1s. 3½d. to 1s. 4d. per gallon for the limited quantities available.

Pyridines.—90/160 grade is 5s. to 5s. 6d. per gallon and 90/140 grade is 5s. 6d. to 6s. per gallon.

Benzole Prices.

These are considered to be the market prices for benzole at the present time:

	s.	d.		s.	d.	
Crude benzole	0	8½	to	0	9	per gallon at works
Motor ,,	1	2	,,	1	2½	,, ,, ,,
90% ,,	1	3	,,	1	3½	,, ,, ,,
Pure ,,	1	7	,,	1	7½	,, ,, ,,

Contracts Advertised To-Day

Coal.

Hoylake Gas Department. [p. 184.]

Excavating and Pipe Laying.

Cleveland Gas Company. [p. 184.]

Pipes.

Cleveland Gas Company. [p. 184.]

Trade Notes

Batley Order for Drakes.

We are informed by Messrs. Drakes, Ltd., Halifax, that they have been successful in obtaining an order from the Batley Corporation for the re-construction of their vertical retort plant.

A Change of Address.

The British Oxygen Company, Ltd., announce that on and after April 14 their Head Office will be Thames House, Millbank, S.W. 1. Their telephone number and telegraphic address remain unchanged.

Gas Undertakings' Results

Colombo.

The report of the Directors of the Colombo Gas and Water Company states that the general trade of the Colony during the year continued to show improvement, and the sales of gas were 10¼ million cu.ft. more than in the previous twelve months. There is a balance of net revenue amounting to £21,389 which the Directors recommend should be appropriated as follows: In paying dividends at the rate of 7% per annum on the 7% preference shares (subject to deduction of income-tax) and 10% per annum on the ordinary shares (subject to deduction of income-tax), less the interim dividends of 3½% and 5% already paid on the two classes of shares respectively. This will leave a balance of £15,585 to be carried forward to the next account.

Leamington.

The report of the Directors of the Leamington Priors Gas Company for the half-year ended Dec. 31, 1935, states that the quantity of gas sold for the half-year shows an increase of 8 million cu.ft., or 4%, over the corresponding half-year of 1934. The number of consumers continues to increase. There has been an increase of £1,400 in the income from gas owing to larger sales. The demand for coke during the winter has proved to be somewhat embarrassing. There has been an improvement in the revenue from coke sales partly owing to a slight increase in the average price received and partly owing to reduced handling charges.

Get the most out of every class of coal in every size of works by adopting

THE WEST SYSTEMS

- GLOVER-WEST VERTICAL RETORTS
- WESTVERTICAL CARBONIZING CHAMBERS
- COAL AND COKE-HANDLING & PREPARATION

Orders for Glover-West vertical retort installations have been received during the present year from the Dudley, Brierley Hill & District Gas Company (3rd order), the Kelso Gas Company, Ltd., the Altrincham Gas Company (3rd order), the Bilston Gas, Light & Coke Company (2nd order), and the Grangemouth Corporation Gas Department (2nd order).

- Carbonizing plants have been recently put into commission at Stratford-on-Avon, Buxton, Kilsyth, Montrose (2nd order), Manchester (6th order), Slough, Johannesburg (2nd order), St. Helens (4th order), St. Albans and Willenhall.

WEST'S GAS IMPROVEMENT COMPANY, LTD.

MANCHESTER: Albion Ironworks, Miles Platting — 'Phone: COLLYHURST 2961 : 'Grams: "STOKER, MANCHESTER"

LONDON: Columbia House, Aldwych, W.C.2 — 'Phone: HOLBORN 4108 : 'Grams: "WESGASCO, ESTRAND, LONDON"

STOCK AND SHARE LIST

Official Quotations on the London Stock Exchange

Issue. £	Stock or Share	When ex-Dividend.	Dividends. Prev. Hf. Yr. % p.a.	Dividends. Last Hf. Yr. % p.a.	NAME.	Quotations Apl. 9.	Rise or Fall on Week.	Transactions, Lowest and Highest Prices During the Week.
1,767,439	Stk.	Mar. 16	7	7⅛	Alliance & Dublin Ord. ...	150—160	...	...
374,000	,,	Dec. 16	4	4	Do. 4 p.c. Deb. ...	95—100	...	...
557,655	,,	Feb. 17	7	7	Barnet Ord. 7 p.c.	167—172	...	169
300,000	1	Mar. 30	1/4½	1/9¾	Bombay, Ltd.	1½—1⅝*	...	26/9
179,305	Stk.	Mar. 2	9½	9½	Bournemouth sliding scale ...	218—228	...	...
590,407	,,	,,	7	7	Do. 7 p.c. max. ...	169—174	...	171—173
493,960	,,	,,	6	6	Do. 6 p.c. Pref. ...	148—153	...	...
50,000	,,	Dec. 16	3	3	Do. 3 p.c. Deb. ...	85—90	...	...
262,025	,,	,,	4	4	Do. 4 p.c. Deb. ...	105—110	...	...
335,000	,,	,,	5	5	Do. 5 p.c. Deb. ...	125—130	...	...
357,900	,,	Feb. 17	7½	7½	Brighton, &c., 6 p.c. Con. ...	170—175	...	...
649,955	,,	,,	6¾	6¾	Do. 5 p.c. Con. ...	155—160	...	158
205,500	,,	,,	6	6	Do. 6 p.c. 'B' Pref.	144—149	...	...
855,000	,,	Mar. 2	7	8	British Ord.	158—163	...	...
100,000	,,	Dec. 16	7	7	Do. 7 p.c. Pref.	153—158	...	...
350,000	,,	,,	5½	5½	Do. 5½ p.c. 'B' Cum. Pref.	110—115	...	...
120,000	,,	,,	4	4	Do. 4 p.c. Red. Deb. ...	96—101	...	...
450,000	,,	,,	5	5	Do. 5 p.c. Red. Deb. ...	107—112	...	...
200,000	,,	,,	17 6§	3½	Do. 3½ p.c. Red. Deb. ...	98—100	...	...
100,000	10	22 May '33	6	4	Cape Town, Ltd.	1—3	...	...
100,000	10	6 Nov. '33	4½	4½	Do. 4½ p.c. Pref. ...	1—3	...	...
150,000	Stk.	Jan. 6	4½	4½	Do. 4½ p.c. Deb. ...	81—86	...	...
626,860	,,	Feb. 3	6	6	Cardiff Con. Ord.	130—135	...	...
237,860	,,	Dec. 16	5	5	Do. 5 p.c. Red. Deb.	110—115	...	...
98,936	1	Sept. 23	2/-	2/-	Colombo, Ltd., Ord.... ...	1⅛—1⅛	...	...
24,500	1	,,	1/4½	1/4½	Do. 7 p.c. Pref. ...	20/—22/-	...	...
609,204	1	Mar. 30	-/11·48	-/11·48	Colonial Gas Assn. Ltd. Ord.	19/—21/ *	...	...
296,053	1	,,	1/3·30	1/3·30	Do. 8 p.c. Pref	23/—25/-*	...	...
1,775,005	Stk.	Feb. 3	5	5	Commercial Ord.	99—103	...	100
620,000	,,	Dec. 2	3	3	Do. 3 p.c. Deb. ...	85—90	...	86
286,314	,,	Feb. 17	5	5	Do. 5 p.c. Deb. ...	120—125	...	124½
807,560	,,	,,	7	7	Croydon sliding scale ...	158—163	...	...
644,590	,,	,,	5	5	Do. max. div.	114—119	...	...
620,385	,,	Dec. 16	5	5	Do. 5 p.c. Deb.... ...	121—126	...	...
239,000	,,	Feb. 3	5	5	East Hull Ord. 5 p.c.... ...	107—110	...	...
184,555	,,	Feb. 17	6	6	East Surrey Ord. 5 p.c. ...	130—135	...	...
176,211	,,	Dec. 16	5	5	Do. 5 p.c. Deb. ...	122—127	...	...
19,284,128	,,	Feb. 3	5⅔	5⅔	Gas Light & Coke 4 p.c. Ord.	27/6—28 6a	+/-3	27/10½—28/3
2,600,000	,,	,,	3⅓	3⅓	Do. 3⅓ p.c. max.... ...	89—92	...	92
4,477,106	,,	,,	4	4	Do. 4 p.c. Con. Pref. ...	105—108	...	106—107
8,602,497	,,	Dec. 2	3	3	Do. 3 p.c. Con. Deb. ...	87—92	...	88—89½
3,642,770	,,	,,	5	5	Do. 5 p.c. Red. Deb. ...	117—120	...	117½
3,500,000	,,	,,	4½	4½	Do. 4½ p.c. Red. Deb. ...	114—117	...	115
270,466	,,	Feb. 17	6	6	Harrogate New Cons. ...	130—135	...	...
157,500	1	Mar. 16	1/7½	1/7½	Hongkong & China, Ltd. ...	1⅞—1⅞	...	...
213,200	Stk.	Mar. 2	6	6	Hornsey Con. 3½ p.c. ...	135—140	...	138—140
5,600,000	,,	Nov. 4	14	8	Imperial Continental Cap. ...	176—181	+3½	177—180
223,130	,,	Jan. 20	3½	3½	Do. 3½ p.c. Red. Debs.	92—97	...	...
285,242	,,	Feb. 17	8½	8½	Lea Bridge 5 p.c. Ord. ...	175—180	...	...
165,736	,,	Mar. 16	8	10	Maidstone 5 p.c. Cap. ...	180—190*	...	...
63,480	,,	Dec. 16	3	3	Do. 3 p.c. Deb. ...	80—85	...	...
75,000	,,	Dec. 2	†10	†10	Malta & Mediterranean ...	200—210	...	...
392,000	—	Apl. 1	5½	5½	Metropolitan (of Melbourne) 5½ p.c. Red. Deb.	102—107*	...	...
231,978	Stk.	Feb. 17	5	5	M.S. Utility 'C' Cons. ...	110—115	...	...
818,657	,,	,,	4	4	Do. 4 p.c. Cons. Pref.	102—107	...	104½
360,075	,,	Dec. 16	4	4	Do. 4 p.c. Deb. ...	103—108	...	...
148,955	,,	,,	5	†5	Do. 5 p.c. Deb. ...	123—128	...	...
125,000	—	Jan. 2	3½	3½	Do. 3½ p.c. Rd. Rg. Bds.	96—99	...	...
675,000	Stk.	Nov. 18	†3	†3	Montevideo, Ltd.	65—70	...	...
225,000	,,	Feb. 17	7½	7½	North Middlesex 6 p.c. Con.	169—174	...	170—172
396,160	,,	Feb. 3	5	5	Northampton 5 p.c. max. ...	108—113	...	...
300,000	,,	Nov. 4	†7	†9	Oriental, Ltd....	167—172	...	...
416,617	,,	Dec. 16	8	8	Plymouth & Stonehouse 5 p.c.	166—171	...	...
504,416	,,	Feb. 3	8½	8½	Portsmouth & Gosport Cons.	170—175	...	...
241,446	,,	,,	5	5	Do. 5 p.c. max. ...	108—113	...	...
114,000	,,	Feb. 3	5	5	Preston 5 p.c. Pref.	110—115	...	...
321,961	1	Sept. 23	...	1/-	Severn Val. Gas Cor. Ld. Ord.	22/—23/-	...	...
319,510	1	Mar. 16	-/10½	-/10½	,, ,, 4½ p.c. Cum. Pref.	21/6—22/6	...	...
133,201	Stk.	Feb. 17	8½	5	Shrewsbury 5 p.c. Ord. ...	147—152	...	...
90,000	10	May 27	†3	†3½	South African...	3—4	...	...
1,061,779	1	Sept. 23	1/2⅞	1/2⅞	South East'n Gas Cn. Ld. Ord.	27/—29/-	...	27/—27/6
845,016	1	Mar. 16	-/10⅝	-/10⅝	Do. 4½ p.c. Red. Cum. Pref.	21/—23/-	...	22/—22/3
200,000	1	,,	4	4	Do. 4 p.c. Cum. Pref. ...	20 9—21/9	...	...
450,000	Stk.	Feb. 17	4	4	Do. 4 p.c. Red. Deb. ...	101—104	...	...
6,709,895	,,	Feb. 3	5	6½	South Met. Ord.	124—127	+1	124½—127
1,135,812	,,	,,	6	6	Do. 6 p.c. Irred. Pf....	147—152	...	148
850,000	,,	,,	4	4	Do. 4 p.c. Irred. Pf....	104—107	...	104½—105
1,895,445	,,	Dec. 16	3	3	Do. 3 p.c. Deb. ...	89—92	...	115
1,000,000	,,	Jan. 6	5	5	Do. 5 p.c. Red. Deb.	114—117	...	...
1,543,795	,,	Feb. 3	6	6	South Suburban Ord. 5 p.c....	131—136	+1	134—135½
512,825	,,	,,	5	5	Do. 5 p.c. Pref....	122—127	...	...
500,000	,,	,,	4	4	Do. 4 p.c. Pref....	103—108	...	...
888,587	,,	Dec. 16	5	5	Do. 5 p.c. Deb....	123—128	...	124—126
250,000	,,	,,	4	4	Do. 4 p.c. Deb....	104—109	...	...
415,907	,,	Dec. 2	...	4	S. Western Gas & Water Ord.	23/—24/-	...	23/-
160,523	,,	Oct. 21	...	...	Do. 4½% Red. Cum. Pref.	22/—23/-	...	...
110,000	,,	Dec. 16	4	4	Do. 4% Red. Deb. ...	98—103	...	...
647,740	,,	Feb. 3	5	5	Southampt'n Ord. 5 p.c. max.	113—118	...	...
121,275	,,	Dec. 16	4	4	Do. 4 p.c. Deb.	98—103	...	...
350,000	,,	Feb. 3	5½	5½	Swansea 5½ p.c. Red. Pref. ...	111—116	...	...
106,000	,,	Dec. 16	6½	6½	Do. 6½ p.c. Red. Deb. ...	96—101	...	...
94,000	,,	...	...	...	Do. 3½ p.c. Red. Deb. ...	96—101	...	...
1,076,490	,,	Feb. 17	6¾	6¾	Tottenham and District Ord.	149—154	...	...
409,835	,,	,,	5⅔	5⅔	Do. 5½ p.c. Pref....	130—135	...	131—132½
62,235	,,	,,	5	5	Do. 5 p.c. Pref. ...	122—127	...	...
371,850	,,	Dec. 2	4	4	Do. 4 p.c. Deb. ...	103—108	...	...
369,774	,,	Feb. 3	7	7	Uxbridge, &c., 5 p.c. ...	153—158	...	...
108,330	,,	,,	5	5	Do. 5 p.c. Pref. ...	122—127	...	...
1,340,521	,,	Feb. 3	7	7	Wandsworth Consolidated ...	158—163	...	...
1,371,373	,,	,,	5	5	Do. 5 p.c. Pref. ...	122—127	...	...
1,317,964	,,	Dec. 16	5	5	Do. 5 p.c. Deb. ...	123—128	...	...
338,300	,,	,,	4	4	Do. 4 p.c. Deb. ...	104—109	...	...
499,735	,,	Feb. 17	6¾	7¼	Watford and St. Albans Ord.	155—160	...	...
200,000	,,	,,	5	5	Do. 5 p.c. Pref. ...	120—125	...	...
200,000	,,	,,	5½	5½	Do. 5½ p.c. Pref. ...	133—138	...	...
200,000	,,	Dec. 2	4	4	Do. 4 p.c. Red. Deb.	100—105	...	...
100,000	,,	,,	...	3½	Do. 3½ p.c. Red. Deb.	96—101	...	...
158,400	,,	Mar. 2	5	6b	Winchester W. & G. 5 p.c. Con.	112—117	...	...

a.—The quotation is per £1 of Stock. b.—Paid £3, including 10s. on account of back dividends. * Ex div.
† Paid free of income-tax. ; For year. § Actual for three months.

Stock and Share List continued overleaf.

Distribution

Domestic Utilization of Gas

by

Smith and Le Fevre

A knowledge of the *principles* of gas utilization is a *sine qua non* of effective salesmanship in the Gas Industry. The aim of this book is to deal simply and logically with these principles; and with it, as a first step, the reader will in some measure be fitted to interpret the mechanism of gaseous combustion, to differentiate between good and bad apparatus and good and bad installation, and to appreciate underlying reasons for modification in design.

It has already proved of the utmost service to thousands of students in the Gas Industry, and is officially recommended by Teachers and Lecturers at many Centres.

Price ***5/6*** *post free*
or
5/- *each for 24 copies*

WALTER KING, LTD.
"Gas Journal" Offices
11, Bolt Court, Fleet Street
London, E.C. 4

STOCK AND SHARE LIST—Cont.

Stocks Officially Quoted on Provincial Exchanges

Issue. £	Stock or Share	When ex-Dividend.	Dividends. Prev. Hf. Yr. % p.a.	Dividends. Last Hf. Yr. % p.a.	NAME.	Quotations. Apl. 9.	Rise or Fall on Week.	Transactions, Lowest and Highest During the Week.
BRISTOL EXCHANGE.								
347,756	Stk.	Feb. 3	5	6	Bath Cons.	124—126	...	...
1,667,250	,,	Feb. 17	5	5	Bristol, 5 p.c. max. ...	119—121	...	...
120,420	,,	Dec. 16	4	4	Do. 1st 4 p.c. Deb. ...	103—105	...	...
217,870	,,	,,	4	4	Do. 2nd 4 p.c. Deb. ...	103—105	...	...
328,790	,,	,,	5	5	Do. 5 p.c. Deb.	125—128	...	...
274,000	,,	Feb. 17	5	5	Newport (Mon.) 5 p.c. max....	111—116	...	...
13,200	12	Mar. 16	7	8½	Pontyp'l Gas & W. 10 p.c. 'A.'	14—15	...	...
13,600	10	,,	5	6	Do. 7 p.c. B.'	11½—12	...	...
40,000	10	,,	5	6	Do. 7 p.c. 'C.'	11½—12	...	...
140,778	Stk.	Feb. 17	5	5	Weston-super-Mare Cons. ...	113—115	...	...
64,338	,,	Dec. 16	4	4	Do. 4 p.c. Deb.	98—100	...	...
33,340	,,	,,	7½	7½	Do. 7½ p.c. Deb.	165—169	...	...
LIVERPOOL EXCHANGE.								
157,150	Stk.	Feb. 3	5	6½	Chester 5 p.c. Ord.	107½—112½	...	...
92,500	,,	Dec. 16	4	4	Do. 4 p.c. Pref.	100—105	...	...
32,540	,,	,,	3½	3½	Do. 3½ p.c. Deb. ...	91—96	...	...
41,890	,,	,,	4	4	Do. 4 p.c. Red. Deb. ...	100—105	...	...
2,167,410	,,	Feb. 17	6	6	Liverpool 5 p.c. Ord. ...	135—137	+1	...
245,500	,,	Dec. 16	5	5	Do. 5 p.c. Red. Pref. ...	103—108	...	...
306,083	,,	Jan. 6	4	4	Do. 4 p.c. Deb. ...	105—107	...	...
106,280	,,	Feb. 3	10	10	Preston 'A' 10 p.c. ...	202—212	...	...
188,219	,,	,,	7	7	Do. 'B' 7 p.c.	140—150	...	...
NEWCASTLE EXCHANGE.								
122,877	Stk.	Mar. 2	8	8	Blyth 5 p.c. Ord.	154—156	...	...
732,000	,,	Feb. 3	5	5	Hartlepool G. & W. Cn. & New	122—124	...	...
2,061,315	,,	Feb. 3	5	5½	Newcastle & Gateshead Con.	25/6—26/6a	...	...
682,886	,,	,,	4	4	Do. 4 p.c. Pref. ...	106½—107½	...	...
776,706	,,	Dec. 16	3½	3½	Do. 3½ p.c. Deb. ...	100½—101½	...	...
277,285	,,	Oct. 21	5	5	Do. 5 p.c. Deb. '43...	105—106	...	...
209,820	,,	Mar. 2	8½	8½	South Shields Con.	165—170	−4½	...
299,542	,,	Feb. 3	6	6	Sunderland 6 p.c. max. ...	129—131	...	...
NOTTINGHAM EXCHANGE.								
542,270	Stk.	Feb. 17	7	10	Derby Con.	175—185	...	...
55,000	,,	Dec. 16	4	4	Do. 4 p.c. Deb.	100—105	...	...
84,750	,,	Feb. 17	5	12	Long Eaton 'A' Ord. ...	150—160	...	...
50,000	,,	,,	4	10	Do. 'B' Ord. ...	130—140	...	...
20,000	10	Dec 16	5	5	Do. 5 p.c. Pref. ...	10—12	...	...
80,000	Stk.	,,	5	5	Do. 5 p.c. Deb. ...	117—122	...	...
SHEFFIELD EXCHANGE.								
10,000	Stk.	Feb. 17	10	10	Great Grimsby 'A' Ord. ...	220—230	...	...
6,500	,,	,,	10	10	Do. 'B' Ord. ...	220—230	...	...
79,000	,,	,,	10	10	Do. 'C' Ord. ...	205—215	...	...
1,806,339	,,	Feb. 17	6	6	Sheffield Cons.	145—148	...	...
95,000	,,	Dec. 16	4	4	Do. 4 p.c. Deb.... ...	100½—102½	...	...

a The quotation is per £1 of Stock.

Supplementary List of Stocks and Shares not Officially Quoted

202,152	Stk.	...	...	...	Ascot Ord.	119—124	...	122½
128,182	,,	...	...	...	Do. 5 p.c. Pref.	117—122	...	...
238,631	1	Nov. 4	5	5	Assd. Gas and Water Ord....	21/—23/-	...	...
323,681	1	,,	4½	4½	Do. 4½ p.c. Cum. Pref. ...	22/—23/-	...	...
150,000	Stk.	...	...	...	Do. 3½ p.c. Red. Deb. ...	...	...	99½—100
17,000	,,	Feb. 17	8	8	Bognor Orig. Ord. 'A' ...	175—185	+13	...
62,210	,,	,,	8	8	Do. New Addl. 'A' ...	172—185	+11½	...
87,160	,,	,,	7	7	Do. New 7 p.c. max. ...	140—145	...	...
37,440	,,	Feb. 3	10	10	Cam.Univ. & Town 10 p.c.max.	210—220	...	...
125,970	,,	,,	7	7	Do. 7 p.c. max.	158—163	...	...
39,025	,,	,,	5	5	Do. 5 p.c. max.	108—113	...	...
65,000	,,	Mar. 2	7½	8½	Eastbourne 'A' 5 p.c. ...	160—165	...	...
198,000	,,	,,	6	7	Do. 'B' 3½ p.c.	133—138	...	...
112,312	,,	,,	5	5	Do. 5 p.c. Pref.	120—125	...	...
130,000	,,	Dec. 16	5	5	Do. 5 p.c. Deb.	122—127	...	...
250,000	1	Nov. 18	...	4	Gas Consolidation Ord. ...	20/6—22/6	...	...
250,000	1	,,	...	4	Do. 4 p.c. Red. Cum. Pref.	19/6—20/6	...	...
24,000	30	Feb. 3	8½	8½	Great Yarmouth 8½ p.c. max.	52—57	...	...
59,400	30	,,	7½	7½	Do. 7½ p.c. max.... ...	42—45	...	...
51,160	Stk.	Dec. 2	5½	5½	Do. 5½ p.c. Deb.... ...	123—128	...	...
152,600	,,	Mar. 2	8	8	Guildford Cons.	185—195	...	...
54,055	,,	,,	5	5	Do. 5 p.c. Pref.	114—119	...	...
68,250	,,	Dec. 16	5	5	Do. 5 p.c. Deb.	120—125	...	...
156,600	,,	Feb. 3	7½	7½	Hampton Court Cons. ...	167—177	...	...
81,660	10	Feb 4,'35	5	9	Leatherhead Ord.	16—17	...	...
107,960	10	Mar. 16	4	5½	Mid Kent Ord.	9½—10½	...	...
230,940	Stk.	Feb. 17	10	10	Oxford & District Ord. ...	205—215	...	...
47,112	,,	,,	5	5	Do. 5 p.c. Pref.	118—123	...	...
50,000	,,	,,	6	6	Do. 6 p.c. Red. Pref. ...	113—118	...	...
126,193	,,	Nov. 18	7½	7½	Peterborough Ord.	160—170	...	...
64,990	,,	Mar. 16	7½	7½	Redditch Ord.	113—118	...	...
166,850	,,	Feb. 17	7	9	Romford Ord.	167—172	...	...
60,000	,,	,,	4	4	Do. 4 p.c. Pref.	97—100	...	...
44,000	,,	Mar. 16	5	5	Do. 5 p.c. Deb.	120—125	...	...
10,950	,,	Mar. 2	8	8	Ryde Ord.	165—170	...	...
136,191	,,	Feb. 3	5	7	Scarborough Ord.	128—138	...	...
27,825	,,	Feb. 3	8	8	Shanklin & Ventnor Cons. ...	152—162	...	...
40,643	,,	Mar. 2	7	7	Slough Ord.	147—152	...	...
221,000	,,	Dec. 16	5	5	Do. 5 p.c. Deb.	116—121	...	...
28,872	1	Nov. 4	5½	5½	S. Midland Gas Cpn.Ltd. Ord.	20/—22/-	...	...
28,866	1	Mar. 16	4½	4½	Do. 4½ p.c. Red. Cum. Pref.	19/6—21/6	...	...
137,730	Stk.	Feb. 17	7	7	Southgate & Dist. 7 p.c. max.	148—153	...	...
62,500	,,	,,	5	5	Do. 5 p.c. Pref.	115—120	...	...
117,228	,,	Mar. 2	5	6	Swindon Cons.	111—116	...	...
60,425	,,	Dec. 16	5	5	Do. 5 p.c. Deb.	122—127	...	...
50,000	1	Mar. 30	...	5·52d.	a Utd. Kingdom Gas Cpn. Ord.	1 5/16—1 7/16*	...	20/3—21/-
760,910	1	,,	2½	2½	Do. 4½ p.c. Prefd. Ord....	20/—22/-*	...	...
110,910	1	,,	...	2½	Do. 4½ p.c. Cum. Pref. ...	20/6—22/6	...	...
900,000	Stk.	Mar. 16	...	3½	Do. 3½ p.c. Red. Deb. ...	98—101	...	99½
130,000	,,	Feb. 3	5	8	Wakefield Ord.	137—142	...	...
81,650	,,	,,	5	5	Do. 5 p.c. max.	101—106	...	...
82,000	,,	Feb. 3	6	6	Weymouth Ord.	106—111	...	...
370,000	,,	Feb. 3	4	6	York Cons.	108—113	...	...
90,000	,,	Dec. 16	5	5	Do. 5 p.c. Red. Deb. ...	103—108	...	...
133,640	,,	Feb. 3	6½	6½	Yorktown (Cam.) 5 p.c. Cons.	127—132	...	...
120,000	,,	,,	5	5	Do. 5 p.c. Pref.	115—120	...	...
35,000	,,	Dec. 16	5½	5½	Do. 5½ p.c. Deb.... ...	130—135	...	...

a Actual.

"Modern Gas Fitting"

PART VI.

of

Gas Fitting Pamphlets

Another of the Popular Series of reprints, in booklet form, of the articles on "Modern Gas Fitting," contributed monthly to the

"GAS SALESMAN"

by

R. N. LeFevre, M.Inst.Gas E.

Officer-in-Charge of Training, The Gas Light and Coke Company, Assistant Head of Department of Gas Engineering and Supply, Westminster Technical Institute.

POST FREE PRICES:

Single Copies, 6d.; 5/6 a dozen. Quantities of 100 for 35/-, plus carriage

WALTER KING, LTD.,

11, Bolt Court, Fleet Street, London, E.C. 4

Parts I to V have been reprinted, and can also be supplied.